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TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, [redacted] 1938

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
PETITIONER,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT

PETITION FOR CERTIORARI FILED AUGUST 27, 1938.

CERTIORARI GRANTED OCTOBER 17, 1938.

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IN THE

United States District Court

SOUTHERN DISTRICT OF NEW YORK.

1

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity, on Letters Patent 1,329,283, 1,349,252, 1,398,665, 1,432,863, 1,442,439, 1,448,550, 1,520,994.

2

Bill of Complaint (Equity No. 50-175).

TO THE HONORABLE THE JUDGES OF THE DISTRICT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK:

Plaintiffs, by this Bill of Complaint, allege: 3

1. That plaintiff, Western Electric Company, Incorporated, is a corporation duly organized and existing under and by virtue of the laws of the State of New York and is a citizen of said State; that plaintiff, Electrical Research Products, Inc., is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware and is a citizen of said State; that plaintiff, American Telephone and Telegraph Company, is a corporation duly organized and existing under and by virtue of the laws of the State of New York and is a citizen of said State;

that, plaintiff, Western Electric Company, Incorporated, is a subsidiary of said plaintiff, American Telephone and Telegraph Company, more than 98% of its corporate stock being owned by said Company; and that plaintiff, Electrical Research Products, Inc., is a subsidiary of plaintiff, Western Electric Company, Incorporated, its entire corporate stock being owned by said Company.

2. That, as plaintiffs are informed and believe and therefore aver, defendant is a corporation existing under and by virtue of the laws of the State of New York and is a citizen and resident of said State.

3. That this is a suit in equity arising under the patent laws of the United States for infringement of the following Letters Patent:

Inventor	*Patent No.*	*Date of Issue*	*Filing Date of Application*
H. D. Arnold	1,329,283	Jan. 27, 1920	July 30, 1918
H. D. Arnold	1,349,252	Aug. 10, 1920	Mar. 20, 1916
H. D. Arnold	1,398,665	Nov. 29, 1921	Jan. 8, 1920
K. S. Johnson	1,432,863	Oct. 24, 1922	July 1, 1918
R. C. Mathes	1,442,439	Jan. 16, 1923	Nov. 4, 1916
H. D. Arnold	1,448,550	Mar. 13, 1923	Feb. 3, 1919
H. D. Arnold	1,520,994	Dec. 30, 1924	Mar. 28, 1919

4. Plaintiffs are informed and believe and therefore aver, with respect to each of the patents in the foregoing list; That the inventor therein named was, prior to the filing date of the application therefor as above given, the first, original and sole inventor of the improvements

and inventions covered thereby, which improvements and inventions were not known or used by others in this country before his invention or discovery thereof and were not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof or more than two years prior to said filing date, and were not in public use or on sale in this country for more than two years prior to said filing date, and had not been abandoned, and had not been patented nor caused 8
to be patented by himself or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to said filing date; that on said filing date he duly filed in the United States Patent Office an application for Letters Patent for said improvements and inventions; and that prior to the said date of issue all of the requirements of the statutes of the United States then in force had been duly complied with.

5. That the aforesaid inventors, Arnold, John- 9
son and Mathes, having severally assigned to the Western Electric Company, Incorporated, their entire right, title and interest in and to the respective applications filed by them as aforesaid and the inventions and improvements therein disclosed, said Patents No. 1,329,283, No. 1,349,252, No. 1,398,665, No. 1,432,863, No. 1,442,439, No. 1,448,550 and No. 1,520,994 were duly issued to plaintiff, Western Electric Company, Incorporated, its successors and assigns; that by instruments in writing duly executed and delivered on or about October 26, 1920, December 14, 1922, February 5, 1924 and January 20, 1926, respec-

tively, and recorded in the United States Patent Office, said Western Electric Company, Incorporated, duly assigned and transferred to plaintiff, American Telephone and Telegraph Company, the entire right, title and interest in and to the said several patents.

6. That plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., are, and at the time of the infringement
11 herein complained of were, engaged in making, selling, leasing, installing and using apparatus for recording sound and apparatus for reproducing sound from records thereof by virtue of licenses from plaintiff, American Telephone and Telegraph Company, under the patents aforesaid for certain purposes, including the field of use of the infringement complained of; and that by an instrument in writing executed and delivered on or about the 7th day of May, 1929, said American Telephone and Telegraph Company confirmed the aforesaid licenses to plaintiff,
12 Western Electric Company, Incorporated, and Electrical Research Products, Inc., and assigned and set over to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., all its rights under or arising from said patents to exclude others from the manufacture, sale, lease, installation and/or use of apparatus, devices, systems or methods for certain purposes, including the field of the infringement herein complained of; and also assigned and set over to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., all claims which had arisen, or which might thereafter arise, out of the in-

fringement of the aforesaid patents within the field of said purposes and the rights for their own benefit to bring suit against any infringer in said field.

7. And plaintiffs pray that the aforesaid Letters Patent, instruments, assignments and agreements in writing may be deemed and taken as a part of the Bill of Complaint and plaintiffs ask leave to refer to the originals of the same or duly authenticated copies thereof, all of which they stand ready in court to produce.

8. That, by virtue of the assignments aforesaid, plaintiff, American Telephone and Telegraph Company, is, and has, at all times since the date of said assignments to said Company, including the time of the infringement herein complained of, been the owner of said Letters Patent No. 1,329,283, No. 1,349,252, No. 1,398,665, No. 1,432,863, No. 1,442,439, No. 1,448,550 and No. 1,520,994, and plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., are entitled to sue jointly with plaintiff, American Telephone and Telegraph Company, for injunctive relief for the infringement of said patents herein complained of and to recover profits and/or damages arising out of said infringement.

9. That plaintiffs have expended large sums of money in making the inventions of said Letters Patent profitable to themselves and their licensees and useful to the public; that they and their licensees have made and sold or caused to be made and sold large numbers of systems, ap-

paratus and electrical amplifiers embodying said inventions and improvements, for the purpose, among others, of the electrical reproduction of sound from records thereof in accompaniment with motion pictures, said systems, apparatus and electrical amplifiers having had affixed thereto the word "Patented" together with the days and years said respective Letters Patent applicable thereto were granted and/or the numbers thereof as provided by Section 4900 of the
17 Revised Statutes of the United States; and that the inventions and improvements of said Letters Patent are of great value, importance, benefit and advantage to the public.

10. That the inventions of said Letters Patent are capable of conjoint use in one and the same unitary structure, device, amplifier or equipment and have been and now are being so used by the defendant in the infringement complained of herein.

18 11. That, as plaintiffs are informed and believe and therefore aver, defendant, without a license under any of said several Letters Patent, and in violation and infringement of each of said Letters Patent, has, within the last six years and prior to the filing of this Bill of Complaint and subsequent to the issue of each of said patents and to the assignments thereof to the plaintiff, American Telephone and Telegraph Company, unlawfully and wrongfully made or caused to be made, sold and used within the United States devices, apparatus, systems, structures, amplifiers and arrangements including arrangements for commercial use in the electrical

reproduction of sound from records thereof in accompaniment with motion pictures, each and all containing the inventions and improvements of each of said Letters Patent or substantial, material and vital parts thereof and each and all infringing upon and/or contributing to the infringement of each of said Letters Patent and upon the aforesaid rights of plaintiffs under each of said Letters Patent and the claims thereof.

12. That, as plaintiffs are informed and believe and therefore aver, defendant has derived and received and will derive and receive from the infringement complained of large gains, profits and advantages, but to what amount plaintiffs are ignorant and cannot set forth; that by reason of said infringement plaintiffs have been and will be deprived of and prevented from receiving, if such infringement is not forthwith restrained by this court, gains, profits and advantages to which plaintiffs are lawfully entitled and which they would have derived and received and would now be deriving and receiving but for the aforesaid infringement; that by reason of the aforesaid infringement plaintiffs have been irreparably injured and have sustained losses and damages therefrom; that unless the infringement is immediately restrained further immediate irreparable injury, loss and damage will be caused to the rights of plaintiffs. 20 21

13. That, as plaintiffs are informed and believe and therefore aver, defendant prior to the commencement of this suit had full knowledge of said several Letters Patent and the aforesaid infringement thereof but notwithstanding such

knowledge is now continuing and threatening to continue said infringement.

WHEREFORE, plaintiffs pray:

1. That a perpetual injunction may be issued enjoining and restraining said defendant and its officers, associates, agents, attorneys, servants, workmen, employees, and each of them, and all those in privity therewith, from in any way in-
23 fringing directly or indirectly or contributing to the infringement of the said Letters Patent or any of the claims thereof.

2. That a preliminary injunction of the same tenor and effect as the perpetual injunction hereinbefore praved for may issue against said defendant pending the determination of this suit and until further order of this court.

3. That defendant be ordered and decreed to deliver to plaintiffs each and all of said infring-
24 ing devices, apparatus, amplifiers or arrangements which it has in its possession or under its control or that the same may be destroyed or that they may be delivered into court or be impounded by the court for such final disposition as to the court may seem just or proper.

4. That defendant be required to account for and pay over to plaintiffs such gains and profits as have accrued or arisen or been earned or received by the said defendant and all such gains and profits as would have accrued to plaintiffs but for the unlawful doings of said defendant, and all damages plaintiffs have sustained thereby, and that the Court will assess the same or

cause them to be assessed under its direction and will increase the same in its discretion as provided by law.

5. That defendant may be decreed to pay the costs, charges and disbursements in this suit and that plaintiffs may have such other and further relief as the circumstances and the equity of the case may require.

Answer under oath is hereby expressly waived.

WESTERN ELECTRIC COMPANY, INCORPORATED, 26

By (S) GEO. C. PRATT,
Vice President.

ELECTRICAL RESEARCH PRODUCTS, INC.,
By (S) J. J. LYNG,
Vice President.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
By (S) CHARLES M. BRACELEN,
Vice President.

CHARLES NEAVE, 27
Solicitor and of Counsel for Plaintiffs.

(S) FRANKLIN T. WOODWARD,
(S) WILLIAM R. BALLARD,
of Counsel for Plaintiffs.

State of New York, }
County of New York, } ss.:

CHARLES M. BRACELEN, being duly sworn deposes and says that he is Vice President of the American Telephone and Telegraph Company, one of the plaintiffs named in the foregoing Bill of Complaint, and that he has read the same and

knows the contents thereof, and that the same is true to his own knowledge except as to the matters therein stated to be alleged on information and belief and as to these matters he believes them to be true; that the reason why this verification is not made by said plaintiff personally is that this plaintiff is a corporation.

(S) CHARLES M. BRACELEN.

Sworn to before me this
12th day of September, 1929.

(S) H. W. HOLLSBERG,
Notary Public.

Amendment to Bill of Complaint (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-175.

Now come the plaintiffs and, in accordance with the provisions of Equity Rule 28, amend

31

the bill of complaint herein in the following respects:

1. Paragraph 2 of the bill of complaint is hereby amended to read as follows:

> "That, as plaintiffs are informed and believe and therefore aver, defendant is a corporation of the State of Delaware, and has a regular and established place of business within the Southern District of New York in which District and elsewhere within the United States it has committed the acts of infringement hereinafter complained of."

32

2. Paragraph 11 of the bill of complaint is hereby amended by inserting in line 9 of the said paragraph after the word "within" the following:

> *the Southern District of New York and elsewhere in*

33

WESTERN ELECTRIC COMPANY, INCORPORATED,
ELECTRICAL RESEARCH PRODUCTS, INC.,
AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

By CHARLES NEAVE,
Solicitor for Plaintiffs.

34

Answer (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-175.

35

For answer to the bill of complaint herein or to as much thereof as defendant is advised is material or required to be answered, defendant says:

36

1. Defendant denies each and every allegation contained in paragraph 2 of the bill of complaint and to the contrary asserts that it is a corporation of the State of Delaware; has committed no acts of infringement within the Southern District of New York and denies that this Court has jurisdiction over it.

2. Defendant denies each and every allegation contained in paragraphs 4, 5 and 6 of the bill of complaint except that it admits having seen what purported to be printed copies of the patents specified in paragraph 3 of the bill of complaint.

3. Defendant has no information sufficient upon which to form a belief as to the matters alleged in paragraph 8 of the bill of complaint and therefore denies the same.

4. Defendant denies each and every allegation contained in paragraphs 9, 10, 11, 12 and 13 of the bill of complaint and therefore denies the same.

Further answering the bill of complaint, but without waiving its jurisdictional rights and under protest as to the jurisdiction of this Court over it, defendant upon information and belief says:

5. That it does not manufacture, use or sell apparatus specified by the bill of particulars, of plaintiffs herein, as being the apparatus charged to infringe the respective Letters Patent in suit.

6. That such apparatus was manufactured and sold defendant as manufactured under the patents in suit by a manufacturer thereof, duly licensed under said patents by the owners thereof or those having rights to grant such licenses.

7. That the apparatus alleged to infringe said Letters Patent were manufactured and sold to defendant by a licensee of the owners of said patents in suit as aforesaid with the knowledge, consent and/or acquiescence of the owners of said patents.

8. Upon information and belief, defendant denies that the alleged Letters Patent or either of them are good and valid in law, and on the

contrary asserts that they and each of them are void and invalid,—

(a) because of want of patentable invention,
(b) because of anticipation by prior publications, and
(c) because of prior knowledge and/or public use.

41 Defendant is not at present possessed of the particulars of the grounds of invalidity or particulars of the acts of invalidity, above specified, but begs leave to add the same hereto by proper amendment when such information and particulars are ascertained.

9. Defendant denies upon information and belief that the apparatus alleged to be an infringement embodies the alleged invention of said Letters Patent or either of them.

42 WHEREFORE this defendant denies that plaintiffs are entitled to the relief prayed for or to any relief, and hence prays to be dismissed with its costs in this cause sustained.

GENERAL TALKING PICTURES CORPORATION,
By (s) DARBY & DARBY,
Attorneys.

Dated, New York, N. Y., August 7th, 1931.

43

Defendant's Bill of Particulars (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50/175.

44

Defendant, for its particulars of Paragraph 8 of its answer, as amended, says:

1. The patents and publications which will be relied upon to establish invalidity of the patents in suit are as follows:

45

As to Arnold Patent No. 1,329,283:

Stone, *et al.*	No. 884,110	granted	Apr. 7, 1908
Reisz	" 1,234,489	"	July 24, 1917
White	" 1,159,307	"	Nov. 2, 1915
Langmuir	" 1,230,768	"	Oct. 8, 1918
Langmuir	" 1,273,627	"	July 23, 1918
Arnold	" 1,129,943	"	Mar. 2, 1915
Seipt	" 1,012,456	"	Dec. 19, 1911
Arnold	" 1,129,942	"	Mar. 2, 1915
Colpitts	" 1,137,384	"	Apr. 27, 1915
Heising	" 1,199,180	"	Sept. 26, 1916
Arnold	" 1,128,280	"	Feb. 16, 1915

46 *Defendant's Bill of Particulars (Equity No. 50-175).*

2. The publications on which defendant will rely to establish the defense of want of patentable invention, in addition to the patents above enumerated, are:

Colpitts	No. 1,129,959	granted Mar.	2, 1915
Armstrong	" 1,113,149	" Oct.	6, 1914
Schloemilch, *et al.*	" 1,087,892	" Feb.	17, 1914
DeForest	" 1,177,848	" Apr.	4, 1916
47 Arnold	" 1,114,845	" Oct.	27, 1914
Nicolson	" 1,169,422	" Jan.	25, 1916

"The Wireless Telephone" by H. Grensbach, Second Edition, published 1911 by The Modern Publishing Company, 233 Fulton Street, New York City.

3. The documentary evidence upon which the defendant will rely in support of its defense that the patentee was not the original and first inventor are the following patents:

48

DeForest	No. 1,375,447	granted Apr.	19, 1921
Langmuir	" 1,558,436	" Oct.	20, 1925
Colpitts	" 1,129,959	" Mar.	2, 1915

4. The patent on which defendant will rely in support of its defense of double patenting is:

Colpitts	No. 1,129,959	granted Mar.	2, 1915

As to Arnold Patent No. 1,349,252:

1. The patents and publications which will be relied upon to establish invalidity of the patent are as follows:

Arnold	No.	1,129,943	granted Mar.	2, 1915
Pierce	"	1,127,371	" Feb.	2, 1915
Stone, *et al.*	"	884,110	" Apr.	7, 1908
Lowenstein	"	1,231,764	" July	3, 1917
Langmuir	"	1,223,496	" Apr.	24, 1917
Armstrong	"	1,113,149	" Oct.	6, 1914
Schloemilch, *et al.*	"	1,087,892	" Feb.	17, 1914
White	"	1,159,307	" Nov.	2, 1915
Nichols	"	1,257,381	" Feb.	16, 1918
Langmuir	"	1,280,768	" Oct.	8, 1918
Langmuir	"	1,273,627	" July	23, 1918
Colpitts	"	1,137,384	" Apr.	27, 1915

50

Article by E. H. Armstrong "Operating Features of the Audion," Electrical World of December 12, 1914, pages 1149-1152.

2. The publications on which defendant will rely to establish the defense of want of patentable invention, in addition to the patents above enumerated, are:

DeForest	No.	1,201,272	granted Oct.	17, 1916
DeForest	"	1,177,848	" Apr.	4, 1916
Reisz	"	1,418,022	" May	30, 1922
Arnold	"	1,114,845	" Oct.	27, 1914
Colpitts	"	1,129,959	" Mar.	2, 1915
Arnold	"	1,129,942	" Mar.	2, 1915
British 2059/14				

51

3. The documentary evidence upon which the defendant will rely in support of its defense that the patentee was not the original and first inventor are the following patents:

52 *Defendant's Bill of Particulars (Equity No. 50-175).*

DeForest	No. 1,375,447	granted Apr.	19, 1921
White	" 1,617,974	" Feb.	15, 1927
Hewitt	" 1,393,369	" Oct.	11, 1921

4. The patent on which defendant will rely in support of its defense of double patenting is:

Arnold	No. 1,329,283	granted Jan.	27, 1920

53 *As to Arnold Patent No. 1,448,550:*

1. The patents and publications which will be relied upon to establish invalidity of the patents in suit are as follows:

Colpitts	No. 1,129,959	granted Mar.	2, 1915
Langmuir	" 1,223,496	" Apr.	24, 1917
Lowenstein	" 1,231,764	" July	3, 1917
VanDer Bijl	" 1,350,752	" Aug.	24, 1920
DeForest	" 1,221,035	" Apr.	3, 1917
Schloemilch, *et al.*	" 1,087,892	" Feb.	17, 1914
DeForest	" 1,177,848	" Apr.	4, 1916
54 White	" 1,159,307	" Nov.	2, 1915
Meissner	" 1,170,552	" Feb.	8, 1916
Von Arco, *et al.*	" 1,314,102	" Aug.	26, 1919
Langmuir	" 1,280,768	" Apr.	8, 1918
Langmuir	" 1,273,627	" July	23, 1918
DeForest	" 1,377,405	" May	10, 1921
Alexanderson	" 1,173,079	" Feb.	22, 1916
Heising	" 1,199,180	" Sept.	26, 1916

2. The publications on which defendant will rely to establish the defense of want of patentable invention, in addition to the patents above enumerated, are:

Stone, *et al.*	No. 884,110	granted Apr.	7, 1908
Colpitts	" Re-14,380	" Oct.	23, 1917
Lindridge	" 1,047,956	" Dec.	24, 1912
Richards	" 1,103,688	" July	14, 1914

3. The documentary evidence upon which the defendant will rely in support of its defense that the patentee was not the original and first inventor are the following:

White	No. 1,617,974	granted Feb.	15, 1927

As to Arnold Patent No. 1,520,994:

The patents and publications which will be relied upon to establish invalidity of the patent is as follows:

Colpitts	No. 1,129,959	granted Mar.	2, 1915
Stone, *et al.*	" 884,110	" Apr.	7, 1908
Langmuir	" 1,223,496	" Apr.	27, 1917
Colpitts	" Re-14,380	" Oct.	23, 1917
Lindridge	" 1,047,956	" Dec.	24, 1912
Lowenstein	" 1,231,764	" July	3, 1917
VanDer Bijl	" 1,350,752	" Aug.	24, 1920
DeForest	" 1,221,035	" Apr.	3, 1917
Schloemilch, *et al.*	" 1,087,892	" Feb.	17, 1914
DeForest	" 1,177,848	" Apr.	4, 1916
White	1,159,307	" Nov.	2, 1915
Von Arco	" 1,314,102	" Aug.	26, 1919
Langmuir	" 1,280,768	" Oct.	8, 1918
DeForest	" 1,377,405	" May	10, 1921
Arnold	" 1,448,550	" Mar.	13, 1923

2. The publications on which defendant will rely to establish the defense of want of patent-

58 able invention, in addition to the patents above enumerated, are:

Alexanderson	No. 1,340,101	granted May	11, 192
Meissner	" 1,170,552	" Feb.	8, 191
DeForest	" 1,201,272	" Oct.	17, 191
Logwood	" 1,218,195	" Mar.	6, 1917
Campbell	" 1,227,113	" May	22, 1917
Langmuir	" 1,273,627	" July	23, 1918
59 DeForest	" 979,276	" Dec.	20, 1910
DeForest	" 1,375,447	" Apr.	19, 1921
French Patent of Addition	" 13,726/11		
British Patent	" 6,101/08		

3. The documentary evidence upon which the defendant will rely in support of its defense that the patentee was not the original and first inventor is:

White No. 1,617,974 granted Feb. 15, 1927

60

4. The patent on which defendant will rely in support of its defense of double patenting is:

Arnold No. 1,448,550 granted Mar. 13, 1923

GENERAL TALKING PICTURES CORPORATION,
By DARBY & DARBY,
Attorneys for Defendant.

Dated: New York, N. Y.,
November 13, 1933.

SAMUEL E. DARBY, JR.,
Counsel for Defendant.

Stipulation and Order Amending Answer (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-175.

It is hereby stipulated that the answer in this cause be amended by the cancellation of subparagraphs (a), (b) and (c) to Paragraph 8 thereof, and the substitution therefor of the following:

(a) because the alleged invention of said patents was described in printed publications of the United States and countries foreign to the United States before the alleged invention of said patents or more than two years prior thereto,

(b) because the said patents disclosed no patentable invention or inventions as distinguished from mechanical skill and natural progress of the art in view of the state of

the art at the time the alleged inventions were made,

(c) because the said patentees were not the original and first inventors of the alleged inventions of said patents,

(d) because the claims of the patents in suit are directed to inventions different from the alleged inventions at the time the ap-
65 plications for said patents were filed and that said claims were first made more than two years subsequent to publication of the said inventions, and

(e) because of double patenting.

HENRY R. ASHTON,
Counsel for Plaintiffs.

New York, N. Y., November 14, 1933.

DARBY & DARBY,
66 Counsel for Defendant.

New York, N. Y., November 13, 1933.

It is so ordered.

JNO. C. KNOX,
U. S. D. J.

Dated: 11/16/33

67

Bill of Complaint (Equity No. 50-177).

IN THE
UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity, on Letters Patent 1,231,764, 1,426,754.

68

TO THE HONORABLE THE JUDGES OF THE DISTRICT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK:

69

Plaintiffs, by this Bill of Complaint, allege:

1. That plaintiff, Western Electric Company, Incorporated, is a corporation duly organized and existing under and by virtue of the laws of the State of New York and is a citizen of said State; that plaintiff, Electrical Research Products, Inc., is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware and is a citizen of said State; that plaintiff, American Telephone and Telegraph Company, is a corporation duly organized and existing under and by virtue of the laws of

the State of New York and is a citizen of said State; that plaintiff, Western Electric Company, Incorporated, is a subsidiary of said plaintiff, American Telephone and Telegraph Company, more than 98% of its corporate stock being owned by said Company; and that plaintiff, Electrical Research Products, Inc., is a subsidiary of plaintiff, Western Electric Company, Incorporated, its entire corporate stock being owned by said Company.

2. That, as plaintiffs are informed and believe and therefore aver, defendant is a corporation existing under and by virtue of the laws of the State of New York and is a citizen and resident of said State.

3. That this is a suit in equity arising under the patent laws of the United States for infringement of the following Letters Patent:

Inventor	*Patent No.*	*Date of Issue*	*Filing Date of Application*
F. Lowenstein	1,231,764	July 3, 1917	Apr. 24, 1912
R. C. Mathes	1,426,754	Aug. 22, 1922	Oct. 23, 1916

4. Plaintiffs are informed and believe and therefore aver, with respect to each of the patents in the foregoing list: That the inventor therein named was, prior to the filing date of the application therefor as above given, the first, original and sole inventor of the improvements and inventions covered thereby, which improvements and inventions were not known or used by others in this country before his invention or discovery thereof and were not patented or

described in any printed publication in this or any foreign country before his invention or discovery thereof or more than two years prior to said filing date, and were not in public use or on sale in this country for more than two years prior to said filing date, and had not been abandoned, and had not been patented nor caused to be patented by himself or his legal representatives or assigns in any foreign country upon an application filed more than twelve months prior to said filing date; that on said filing date 74 he duly filed in the United States Patent Office an application for Letters Patent for said improvements and inventions; and that prior to the said date of issue all of the requirements of the statutes of the United States then in force had been duly complied with.

5. That the said Lowenstein Patent No. 1,231,764, was duly issued to Fritz Lowenstein, his heirs and assigns; and that by an instrument in writing duly executed on or about September 5, 1918, and recorded in the United States Patent 75 Office, the said Fritz Lowenstein duly assigned and transferred to plaintiff, American Telephone and Telegraph Company, the entire right, title and interest in and to said patent.

6. That the said inventor, Mathes, having assigned to the Western Electric Company, Incorporated, his entire right, title and interest in and to the application filed by him October 23, 1916, as aforesaid and the inventions and improvements therein disclosed, said Patent No. 1,426,754, was duly issued to plaintiff, Western Electric Company, Incorporated, its successors

and assigns; that by an instrument in writing duly executed and delivered on or about November 11, 1922, and recorded in the United States Patent Office, said Western Electric Company, Incorporated, duly assigned and transferred to plaintiff, American Telephone and Telegraph Company the entire right, title and interest in and to the said patent.

7. That plaintiffs, Western Electric Company,
77 Incorporated, and Electrical Research Products, Inc., are, and at the time of the infringement herein complained of were, engaged in making, selling, leasing, installing and using apparatus for recording sound and apparatus for reproducing sound from records thereof by virtue of licenses from plaintiff, American Telephone and Telegraph Company, under the patents aforesaid for certain purposes, including the field of use of the infringement complained of; and that by an instrument in writing executed and delivered on or about the 7th day of May, 1929,
78 said American Telephone and Telegraph Company confirmed the aforesaid licenses to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products Inc., and assigned and set over to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., all its rights under or arising from said patents to exclude others from the manufacture, sale, lease, installation and/or use of apparatus, devices, systems or methods for certain purposes, including the field of the infringement herein complained of; and also assigned and set over to plaintiffs, Western Electric Company, Incorporated, and Electrical Re-

search Products, Inc., all claims which had arisen, or which might thereafter arise, out of the infringement of the aforesaid patents within the field of said purposes and the rights for their own benefit to bring suit against any infringer in said field.

8. And plaintiffs pray that the aforesaid Letters Patent, instruments, assignments and agreements in writing may be deemed and taken as a part of this Bill of Complaint and plaintiffs 80
ask leave to refer to the originals of the same or duly authenticated copies thereof, all of which they stand ready in court to produce.

9. That, by virtue of the assignments aforesaid, plaintiff, American Telephone and Telegraph Company, is, and has, at all times since the date of said assignments to said Company, including the time of the infringement herein complained of, been the owner of said Letters Patent No. 1,231,764, and 1,426,754, and plaintiffs, Western Electric Company, Incorporated, and 81
Electrical Research Products, Inc., are entitled to sue jointly with plaintiff, American Telephone and Telegraph Company, for injunctive relief for the infringement of said patents herein complained of and to recover profits and/or damages arising out of said infringement.

10. That plaintiffs have expended large sums of money in making the inventions of said Letters Patent profitable to themselves and their licensees and useful to the public; that they and their licensees have made and sold or caused to be made and sold large number of systems, ap-

paratus and electrical amplifiers embodying said inventions and improvements, for the purpose, among others, of the electrical reproduction of sound, from records thereof in accompaniment with motion pictures, said systems, apparatus and electrical amplifiers having had affixed thereto the word "Patented" together with the days and years said respective Letters Patent applicable thereto were granted and/or the numbers thereof as provided by Section 4900 of the Re-
83 vised Statutes of the United States; and that the inventions and improvements of said Letters Patent are of great value, importance, benefit and advantage to the public.

11. That, as plaintiffs are informed and believe and therefore aver, said Letters Patent No. 1,231,764 and No. 1,426,754, have been in litigation in a suit in the United States District Court for the Southern District of New York brought by the Radio Corporation of America and others (being licensees of said American Telephone
84 and Telegraph Company, plaintiff herein) as plaintiffs, against J. H. Bunnell & Company, Inc., and others as defendants; that after trial and decision in said suit an interlocutory decree was entered therein on or about June 5, 1928, sustaining claims 1 and 7 of said Patent No. 1,231,764, and claim 8 of said Patent No. 1,426,754; that the aforesaid decree is now in full force and effect as will more fully appear by reference to the records in said suit to which plaintiffs pray leave to refer.

12. That the inventions of said Letters Patent are capable of conjoint use in one and the

same unitary structure, device, amplifier or equipment and have been and now are being so used by the defendant in the infringement complained of herein. 85

13. That, as plaintiffs, are informed and believe and therefore aver, defendant, without a license under either of said several Letters Patent, and in violation and infringement of each of said Letters Patent, has, within the last six years and prior to the filing of this Bill of Complaint and subsequent to the issue of each of said patents and to the assignments thereof to the plaintiff, American Telephone and Telegraph Company unlawfully and wrongfully made or caused to be made, sold and used within the United States devices, apparatus, systems, structures, amplifiers and arrangements including arrangements for commercial use in the electrical reproduction of sound from records thereof in accompaniment with motion pictures, each and all containing the inventions and improvements of each of said Letters Patent or substantial, material and vital parts thereof and each and all infringing upon and/or contributing to the infringement of each of said Letters Patent and upon the aforesaid rights of plaintiffs under each of said Letters Patent and the claims thereof. 86 87

14. That, as plaintiffs are informed and believe and therefore aver, defendant has derived and received and will derive and receive from the infringement complained of large gains, profits and advantages, but to what amount plaintiffs are ignorant and cannot set forth; that by reason of said infringement plaintiffs have been and

will be deprived of and prevented from receiving, if such infringement is not forthwith restrained by this court, gains, profits and advantages to which plaintiffs are lawfully entitled and which they would have derived and received and would now be deriving and receiving but for the aforesaid infringement; that by reason of the aforesaid infringement plaintiffs have been irreparably injured and have sustained losses and damages therefrom; that unless the infringe-
89 ment is immediately restrained further immediate irreparable injury, loss and damage will be caused to the rights of plaintiffs.

15. That, as plaintiffs are informed and believe and therefore aver, defendant prior to the commencement of this suit had full knowledge of said several Letters Patent and the aforesaid infringement thereof but notwithstanding such knowledge is now continuing and threatening to continue said infringement.

90 WHEREFORE, plaintiffs pray:

1. That a perpetual injunction may be issued enjoining and restraining said defendant and its officers, associates, agents, attorneys, servants, workmen, employees, and each of them, and all those in privity therewith, from in any way infringing directly or indirectly or contributing to the infringement of the said Letters Patent or any of the claims thereof.

2. That a preliminary injunction of the same tenor and effect as the perpetual injunction hereinbefore prayed for may issue against said de-

fendant pending the determination of this suit and until further order of this court.

3. That defendant be ordered and decreed to deliver to plaintiffs each and all of said infringing devices, apparatus, amplifiers or arrangements which it has in its possession or under its control or that the same may be destroyed or that they may be delivered into court or be impounded by the court for such final disposition as to the court may seem just or proper. 92

4. That defendant be required to account for and pay over to the plaintiffs such gains and profits as have accrued or risen or been earned or received by the said defendant and all such gains and profits as would have accrued to plaintiffs but for the unlawful doings of said defendant, and all damages plaintiffs have sustained thereby, and that the Court will assess the same or cause them to be assessed under its direction and will increase the same in its discretion as provided by law.

5. That defendant may be decreed to pay the costs, charges and disbursements in this suit and that plaintiffs may have such other and further relief as the circumstances and the equity of the case may require. 93

Answer under oath is hereby expressly waived.

WESTERN ELECTRIC COMPANY, INCORPORATED,

By (S) GEO. C. PRATT,
Vice President.

ELECTRICAL RESEARCH PRODUCTS, INC.,
By (S) J. J. LYNG,
Vice President.

94 *Bill of Complaint (Equity No. 50-177).*

AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
By (S) CHARLES M. BRACELEN,
Vice President.

CHARLES NEAVE,
Solicitor and of Counsel for Plaintiffs.

(S) FRANKLIN T. WOODWARD,
(S) WILLIAM R. BALLARD,
95 of Counsel for Plaintiffs.

State of New York, }
County of New York, } ss.:

CHARLES M. BRACELEN, being duly sworn deposes and says that he is Vice President of the American Telephone and Telegraph Company, one of the plaintiffs named in the foregoing Bill of Complaint, and that he has read the same and knows the contents thereof, and that the same is
96 true to his own knowledge except as to the matters therein stated to be alleged on information and belief and as to these matters he believes them to be true; that the reason why this verification is not made by said plaintiff personally is that this plaintiff is a corporation.

(S) CHARLES M. BRACELEN.

Sworn to before me this
5th day of September, 1929.

(S) J. A. GATELY,
Notary Public.

Amendment to Bill of Complaint (Equity No. 50-177). 97

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-177. 98

Now come the plaintiffs and, in accordance with the provisions of Equity Rule 28, amend the bill of complaint herein in the following respects:

1. Paragraph 2 of the bill of complaint is hereby amended to read as follows: 99

> "That, as plaintiffs are informed and believe and therefore aver, defendant is a corporation of the State of Delaware, and has a regular and established place of business within the Southern District of New York in which District and elsewhere within the United States it has committed the acts of infringement hereinafter complained of."

2. Paragraph 13 of the bill of complaint is hereby amended by inserting in line 9 of the said

100 *Answer (Equity No. 50-177).*

paragraph after the word "within" the following:

the Southern District of New York and elsewhere in

WESTERN ELECTRIC COMPANY, INCORPORATED,
ELECTRICAL RESEARCH PRODUCTS, INC.,
AMERICAN TELEPHONE AND TELEGRAPH
101 COMPANY,

By CHARLES NEAVE,
Solicitor for Plaintiffs.

Answer (Equity No. 50-177).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

102

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50/177.

For answer to the bill of complaint herein or to as much thereof as defendant is advised is

material or required to be answered, defendant says:

1. Defendant denies each and every allegation contained in paragraph 2 of the bill of complaint and to the contrary asserts that it is a corporation of the State of Delaware, has committed no acts of infringement within the Southern District of New York, and denies that this Court has jurisdiction over it.

104

2. Defendant denies each and every allegation contained in paragraphs 4, 5, 6 and 7 of the bill of complaint except that it admits having seen what purported to be printed copies of the patents specified in paragraph 3 of the bill of complaint.

3. Defendant has no information sufficient upon which to form a belief as to the matters alleged in paragraph 9 of the bill of complaint and therefore denies the same.

105

4. Defendant denies each and every allegation contained in paragraphs 10, 12, 13, 14 and 15 of the bill of complaint and therefore denies the same.

Further answering the bill of complaint, but without waiving its jurisdictional rights and under protest as to the jurisdiction of this Court over it, defendant upon information and belief says:

5. That it does not manufacture, use or sell apparatus specified by the bill of particulars of plaintiffs herein as being the apparatus charged to infringe the respective Letters Patent in suit.

6. That such apparatus was manufactured and sold defendant as manufactured under the patents in suit, by a manufacturer thereof, duly licensed under said patents by the owners thereof, or those having rights to grant such licenses.

7. That the apparatus alleged to infringe said Letters Patent were manufactured and sold to defendant by a licensee of the owners of said patent in suit as aforesaid with the knowledge, consent and/or acquiescence of the owners of said patent.

8. Upon information and belief, defendant denies that the alleged Letters Patent or either of them are good and valid in law, and on the contrary asserts that they and each of them are void and invalid,

(a) because of want of patentable invention,
(b) because of anticipation of prior publications, and
(c) because of prior knowledge and/or public use.

Defendant is not at present possessed of the particulars of the grounds of invalidity or particulars of the acts of invalidity, above specified, but begs leave to add the same hereto by proper amendment when such information and particulars are ascertained.

9. Defendant denies upon information and belief that the apparatus alleged to be an infringement embodies the alleged invention of said Letters Patent or either of them.

10. As to the matter set forth in paragraph 11 of the said bill of complaint, defendant admits the allegations therein contained, but asserts the allegations therein are incomplete in that said Lowenstein patent No. 1,231,764, has been adjudged to be invalid in law by the United States District Court for the Eastern District of New York in a decision recently rendered in that Court brought by the plaintiffs herein against one, Sol Wallerstein, identified in that Court as Equity No. 7.

WHEREFORE, this defendant denies that plaintiffs are entitled to the relief prayed for or to any relief, and hence prays to be dismissed with its costs in this cause sustained.

GENERAL TALKING PICTURES CORPORATION,
By DARBY & DARBY,
Attorneys.

Dated, New York, N. Y., August 7th, 1931.

112

Defendant's Bill of Particulars (Equity No. 50-177).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50/177.

113

Defendant, for its particulars of Paragraph 8 of its answer, as amended, says:

1. The patents and publications which will be relied upon to establish invalidity of the patents in suit are as follows:

114

As to Lowenstein Patent No. 1,231,764 (all claims except claim 3):

Weintraub, *et al.*	No. 921,930	granted May	18, 1909
VonLieben, *et al.*	" 1,038,910	" Sept.	17, 1912
DeForest	" 841,387	" Jan.	15, 1907
Stone, *et al.*	" 884,110	" Apr.	7, 1908
DeForest	" 879,532	" Feb.	18, 1908
DeForest	" 995,126	" June	13, 1911
French Patent of Addition	" 13,726/11		

115

As to Mathes Patent No. 1,426,754:

Leisz	No. 1,418,022	granted May	30, 1922
Leisz	" 1,234,489	" July	24, 1917
DeForest	" 979,276	" Dec.	20, 1910
Meissner	" 1,170,552	" Feb.	8, 1916
Arnold	" 1,129,943	" Mar.	2, 1915
White	" 1,195,632	" Aug.	22, 1916
Pickard	" 1,128,817	" Feb.	16, 1915
VonLieben, *et al.*	" 1,038,910	" Sept.	17, 1912
Colpitts, *et al.*	" 1,388,450	" Aug.	23, 1921
German Patent	" 217,073		
German Patent	" 249,149		
British Patent	" 1,482/11		

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2. The instances of the prior art on which defendant will rely to establish the defense of want of patentable invention are the patents above enumerated in addition to the following:

Colpitts	No. 1,137,384	granted Apr.	27, 1915
VonLieben, *et al.*	" Re-13,779	" July	21, 1914
Meising	" 1,199,180	" Sept.	26, 1916
Pierce	" 1,127,371	" Feb.	2, 1915
Langmuir	" 1,223,496	" Apr.	24, 1917
Langmuir	" 1,273,627	" July	23, 1918
Arnold	" 1,129,942	" Mar.	2, 1915
German Patent	No. 268,460		
British Patent	" 13,248/14		

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GENERAL TALKING PICTURES CORPORATION,
By DARBY & DARBY,
Attorneys for Defendant.

Dated: New York, N. Y.,
November 13, 1933.

SAMUEL E. DARBY, JR.,
Counsel for Defendant.

118

Stipulation and Order Amending Answer (Equity No. 50-177).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-177.

119

It is hereby stipulated that the answer in this cause be amended by the cancellation of subparagraphs (a), (b) and (c) to Paragraph 8 thereof, and the substitution therefor of the following:

120

(a) because the alleged invention of said patents was described in printed publications of the United States and countries foreign to the United States before the alleged invention of said patents or more than two years prior thereto,

(b) because the said patents disclosed no patentable invention or inventions as distinguished from mechanical skill and natural progress of the art in view of the state of the art at the time the alleged inventions were made,

121

(c) because the said patentees were not the original and first inventors of the alleged inventions of said patents,

(d) because the claims of the patents in suit are directed to inventions different from the alleged inventions at the time the applications for said patents were filed and that said claims were first made more than two years subsequent to publication of the said inventions, and

122

(e) because of double patenting.

HENRY R. ASHTON,
Counsel for Plaintiffs.

New York, N. Y., November 14, 1933.

DARBY & DARBY,
Counsel for Defendant.

New York, N. Y., November 13, 1933.

123

It is so ordered.

JNO. C. KNOX,
U. S. D. J.

Dated: 11/16/33

124

Bill of Complaint (Equity No. 50-178).

IN THE
UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

125 Plaintiffs,

against

GENERAL TALKING PICTURES CORPORATION;

Defendant.

In Equity, on Letters Patent 1,129,942, 1,403,475, 1,465,332.

TO THE HONORABLE THE JUDGES OF THE DISTRICT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK:

126 Plaintiffs, by this Bill of Complaint, allege:

1. That plaintiff, Western Electric Company, Incorporated, is a corporation duly organized and existing under and by virtue of the laws of the State of New York and is a citizen of said State; that plaintiff, Electrical Research Products, Inc., is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware and is a citizen of said State; that plaintiff, American Telephone and Telegraph Company, is a corporation duly organized and existing under and by virtue of the laws of

the State of New York and is a citizen of said State; that plaintiff, Western Electric Company, Incorporated, is a subsidiary of said plaintiff, American Telephone and Telegraph Company, more than 98% of its corporate stock being owned by said Company; and that plaintiff, Electrical Research Products, Inc., is a subsidiary of plaintiff, Western Electric Company, Incorporated, its entire corporate stock being owned by said Company.

2. That, as plaintiffs are informed and believe and therefore aver, defendant is a corporation existing under and by virtue of the laws of the State of New York and is a citizen and resident of said State.

3. That this is a suit in equity arising under the patent laws of the United States for infringement of the following Letters Patent:

Inventor	*Patent No.*	*Date of Issue*	*Filing Date of Application*
H. D. Arnold	1,129,942	Mar. 2, 1915	May 28, 1914
H. D. Arnold	1,403,475	Jan. 17, 1922	Nov. 11, 1920
H. D. Arnold	1,465,332	Aug. 21, 1923	Sept. 3, 1915

4. Plaintiffs are informed and believe and therefore aver that with respect to each of the patents in the foregoing list, said Arnold was, prior to the filing date of the application therefor as above given, the first, original and sole inventor of the improvements and inventions covered thereby, which improvements and inventions were not known or used by others in this country before his invention or discovery there-

of and were not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof or more than two years prior to said filing date, and were not in public use or on sale in this country for more than two years prior to said filing date, and had not been abandoned, and had not been patented nor caused to be patented by himself or his legal representatives or assigns in any foreign country upon an application filed
131 more than twelve months prior to said filing date; that on said filing date he duly filed in the United States Patent Office an application for Letters Patent for said improvements and inventions; and that prior to the said date of issue all the requirements of the statutes of the United States then in force had been duly complied with.

5. That said Arnold, having assigned to the Western Electric Company, a corporation of Illinois, his entire right, title and interest in and
132 to the application filed by him on May 28, 1914, as aforesaid, and the inventions and improvements therein disclosed, said Patent No. 1,129,942 was duly issued to said Western Electric Company, its successors and assigns; and that by an instrument in writing duly executed and delivered on or about November 24, 1915, and recorded in the United States Patent Office, said Western Electric Company duly assigned and transferred to plaintiff, Western Electric Company, Incorporated, the entire right, title and interest in and to the said patent; that by an instrument in writing duly executed and delivered on or about December 8, 1915, and re-

corded in the United States Patent Office, the plaintiff, Western Electric Company, Incorporated, duly assigned and transferred to plaintiff, American Telephone and Telegraph Company, the entire right, title and interest in and to said patent.

6. That said Arnold, having assigned to the Western Electric Company, Incorporated, his entire right, title and interest in and to the applications filed by him on November 11, 1920, and 134
September 3, 1915, as aforesaid, and the inventions and improvements therein disclosed, said Patents No. 1,403,475 and No. 1,465,332 were duly issued to plaintiff, Western Electric Company, Incorporated, its successors and assigns; that by instruments in writing duly executed and delivered on or about December 14, 1922 and February 5, 1924, respectively, and recorded in the United States Patent Office, said Western Electric Company, Incorporated, duly assigned and transferred to plaintiff, American Telephone and Telegraph Company, the entire right, title 135
and interest in and to the said patents.

7. That plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., are, and at the time of the infringement herein complained of were, engaged in making, selling, leasing, installing and using apparatus for recording sound and apparatus for reproducing sound from records thereof by virtue of licenses from plaintiff, American Telephone and Telegraph Company, under the patents aforesaid for certain purposes, including the field of use of the infringement complained of; and that by

an instrument in writing executed and delivered on or about the 7th day of May, 1929, said American Telephone and Telegraph Company confirmed the aforesaid licenses to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., and assigned and set over to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., all its rights under or arising from said patents to exclude others from the
137 manufacture, sale, lease, installation and/or use of apparatus, devices, systems or methods for certain purposes, including the field of the infringement herein complained of; and also assigned and set over to plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., all claims which had arisen, or which might thereafter arise, out of the infringement of the aforesaid patents within the field of said purposes and the rights for their own benefit to bring suit against any infringer in said field.

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8. And plaintiffs pray that the aforesaid Letters Patent, instruments, assignments and agreements in writing may be deemed and taken as a part of this Bill of Complaint and plaintiffs ask leave to refer to the originals of the same or duly authenticated copies thereof, all of which they stand ready in court to produce.

9. That, by virtue of the assignments aforesaid, plaintiff, American Telephone and Telegraph Company, is, and has, at all times since the date of said assignments to said Company, including the time of the infringement herein

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complained of, been the owner of said Letters Patent No. 1,129,942, No. 1,403,475 and No. 1,465,-332, and plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products, Inc., are entitled to sue jointly with plaintiff, American Telephone and Telegraph Company, for injunctive relief for the infringement of said patents herein complained of and to recover profits and/or damages arising out of said infringement.

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10. That plaintiffs have expended large sums of money in making the inventions of said Letters Patent profitable to themselves and their licensees and useful to the public; that they and their licensees have made and sold or caused to be made and sold large numbers of systems, apparatus and electrical amplifiers embodying said inventions and improvements, for the purpose, among others, of the electrical reproduction of sound from records thereof in accompaniment with motion pictures, said systems, apparatus and electrical amplifiers having had affixed there- 141 to the word "Patented" together with the days and years said respective Letters Patent applicable thereto were granted and/or the numbers thereof as provided by Section 4900 of the Revised Statutes of the United States; and that the inventions and improvements of said Letters Patent are of great value, importance, benefit and advantage to the public.

11. That the inventions of said Letters Patent are capable of conjoint use in one and the same unitary structure, device, amplifier or equipment and have been and now are being so used

by the defendant in the infringement complained of herein.

12. That, as plaintiffs are informed and believe and therefore aver, defendant, without a license under either of said several Letters Patent, and in violation and infringement of each of said Letters Patent, has, within the last six years and prior to the filing of this Bill of Complaint and subsequent to the issue of each of
143 said patents and to the assignments thereof to the plaintiff, American Telephone and Telegraph Company, unlawfully and wrongfully made or caused to be made, sold and used within the United States devices, apparatus, systems, structures, amplifiers and arrangements including arrangements for commercial use in the electrical reproduction of sound from records thereof in accompaniment with motion pictures, each and all containing the inventions and improvements of each of said Letters Patent or substantial, material and vital parts thereof and each and all
144 infringing upon and/or contributing to the infringement of each of said Letters Patent and upon the aforesaid rights of plaintiffs under each of said Letters Patent and the claims thereof.

13. That, as plaintiffs are informed and believe and therefore aver, defendant has derived and received and will derive and receive from the infringement complained of large gains, profits and advantages, but to what amount plaintiffs are ignorant and cannot set forth; that by reason of said infringement plaintiffs have been and will be deprived of and prevented from re-

ceiving, if such infringement is not forthwith restrained by this court, gains, profits and advantages to which plaintiffs are lawfully entitled and which they would have derived and received and would now be deriving and receiving but for the aforesaid infringement; that by reason of the aforesaid infringement plaintiffs have been irreparably injured and have sustained losses and damages therefrom; that unless the infringement is immediately restrained further immediate irreparable injury, loss and damage will be caused to the rights of plaintiffs.

14. That, as plaintiffs are informed and believe and therefore aver, defendant prior to the commencement of this suit had full knowledge of said several Letters Patent and the aforesaid infringement thereof but notwithstanding such knowledge is now continuing and threatening to continue said infringement.

WHEREFORE plaintiffs pray:

1. That a perpetual injunction may be issued enjoining and restraining said defendant and its officers, associates, agents, attorneys, servants, workmen, employees, and each of them, and all those in privity therewith, from in any way infringing directly or indirectly or contributing to the infringement of the said Letters Patent or any of the claims thereof.

2. That a preliminary injunction of the same tenor and effect as the perpetual injunction hereinbefore prayed for may issue against said defendant pending the determination of this suit and until further order of this court.

148 *Bill of Complaint (Equity No. 50-178).*

3. That defendant be ordered and decreed to deliver to plaintiffs each and all of said infringing devices, apparatus, amplifiers or arrangements which it has in its possession or under its control or that the same may be destroyed or that they may be delivered into court or be impounded by the court for such final disposition as to the court may seem just and proper.

4. That defendant be required to account for
149 and pay over to plaintiffs such gains and profits as have accrued or risen or been earned or received by the said defendant and all such gains and profits as would have accrued to plaintiffs but for the unlawful doings of said defendant, and all damages plaintiffs have sustained thereby, and that the Court will assess the same or cause them to be assessed under its direction and will increase the same in its discretion as provided by law.

5. That defendant may be decreed to pay the
150 costs, charges and disbursements in this suit and that plaintiffs may have such other and further relief as the circumstances and the equity of the case may require.

Answer under oath is hereby expressly waived.

WESTERN ELECTRIC COMPANY, INCORPORATED,

By (S) GEO. C. PRATT,
Vice President.

ELECTRICAL RESEARCH PRODUCTS, INC.,

By (S) J. J. LYNG,
Vice President.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
By (S) CHARLES M. BRACELEN,
Vice President.

CHARLES NEAVE,
Solicitor and of Counsel for Plaintiffs.

(S) FRANKLIN T. WOODWARD,
(S) WILLIAM R. BALLARD,
of Counsel for Plaintiffs.

State of New York, }
County of New York, } ss.:

CHARLES M. BRACELEN, being duly sworn, deposes and says that he is Vice President of the American Telephone and Telegraph Company, one of the plaintiffs named in the foregoing Bill of Complaint, and that he has read the same and knows the contents thereof, and that the same is true to his own knowledge except as to the matters therein stated to be alleged on information and belief and as to these matters he believes them to be true; that the reason why this verification is not made by said plaintiff personally is that this plaintiff is a corporation.

(S) CHARLES M. BRACELEN.

Sworn to before me this
12th day of September, 1929.

(S) H. W. HOLLSBERG,
Notary Public.

154 **Amendment to Bill of Complaint (Equity No. 50-178).**

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs,	Equity No. 50-178.
155 vs.	
GENERAL TALKING PICTURES CORPORATION, Defendant.	

Now come the plaintiffs and, in accordance with the provisions of Equity Rule 28, amend the bill of complaint herein in the following respects:

156 1. Paragraph 2 of the bill of complaint is hereby amended to read as follows:

> "That, as plaintiffs are informed and believe and therefore aver, defendant is a corporation of the State of Delaware, and has a regular and established place of business within the Southern District of New York in which District and elsewhere within the United States it has committed the acts of infringement hereinafter complained of."

2. Paragraph 12 of the bill of complaint is hereby amended by inserting in line 8 of the said paragraph after the word "within" the following:

the Southern District of New York and elsewhere in

WESTERN ELECTRIC COMPANY, INCORPORATED,
ELECTRICAL RESEARCH PRODUCTS, INC.,
AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

By CHARLES NEAVE,
Solicitor for Plaintiffs. 158

Answer (Equity No. 50-178).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-178.

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For answer to the bill of complaint herein or to as much thereof as defendant is advised is

160 *Answer (Equity No. 50-178).*

material or required to be answered, defendant says:

1. Defendant denies each and every allegation contained in paragraph 2 of the bill of complaint and to the contrary asserts that it is a corporation of the State of Delaware; has committed no acts of infringement within the Southern District of New York, and denies that this Court has jurisdiction over it.

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2. Defendant denies each and every allegation contained in paragraphs 4, 5, 6 and 7 of the bill of complaint except that it admits having seen what purported to be printed copies of the patents specified in paragraph 3 of the bill of complaint.

3. Defendant has no information sufficient upon which to form a belief as to the matters alleged in paragraph 9 of the bill of complaint and therefore denies the same.

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4. Defendant denies each and every allegation contained in paragraphs 10, 11, 12, 13 and 14 of the bill of complaint and therefore denies the same.

Further answering the bill of complaint, but without waiving its jurisdictional rights and under protest as to the jurisdiction of this Court over it, defendant upon information and belief says:

5. That it does not manufacture, use or sell apparatus specified by the bill of particulars of plaintiffs herein as being the apparatus charged to infringe the respective Letters Patent in suit.

6. That such apparatus was manufactured and sold defendant as manufactured under the patents in suit by a manufacturer thereof, fully licensed under said patents by the owners thereof or those having rights to grant such licenses.

7. That the apparatus alleged to infringe said Letters Patent were manufactured and sold to defendant by a licensee of the owners of said patents in suit as aforesaid with the knowledge, consent and/or acquiescence of the owners of 164 said patent.

8. Upon information and belief, defendant denies that the alleged Letters Patent or either of them are good and valid in law, and on the contrary asserts that they and each of them are void and invalid,—

(a) because of want of patentable invention,
(b) because of anticipation by prior publications, and
(c) because of prior knowledge and/or 165 public use.

Defendant is not at present possessed of the particulars of the grounds of invalidity or particulars of the acts of invalidity, above specified, but begs leave to add the same hereto by proper amendment when such information and particulars are ascertained.

9. Defendant denies upon information and belief that the apparatus alleged to be an infringement embodies the alleged invention of said Letters Patent or either of them.

166 *Defendant's Bill of Particulars (Equity No. 50-178).*

WHEREFORE, this defendant denies that plaintiffs are entitled to the relief prayed for or to any relief, and hence prays to be dismissed with its costs in this cause sustained.

GENERAL TALKING PICTURES CORPORATION,
By DARBY & DARBY,
Attorneys.

167 Dated, New York, N. Y., August 7th, 1931.

Defendant's Bill of Particulars (Equity No. 50-178).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

168 WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Plaintiffs,
vs.
GENERAL TALKING PICTURES CORPORATION,
Defendant.

Equity #50/178.

Defendant, for its particulars of Paragraph 8 of its answer, as amended, says:

Defendant's Bill of Particulars
(Equity No. 50-178).

169

1. The patents and publications which will be relied upon to establish invalidity of the patents in suit are as follows:

As to Arnold Patent No. 1,403,475:

Arnold	No.	1,114,845	granted Oct.	27, 1914
Arnold	"	1,118,176	" Nov.	24, 1914
Colpitts	"	1,137,384	" Apr.	27, 1915
DeForest	"	1,221,035	" Apr.	3, 1917
Langmuir	"	1,223,496	" Apr.	24, 1917
DeForest	"	1,348,157	" Aug.	3, 1920
Armstrong	"	1,113,149	" Oct.	6, 1914
Marconi	"	792,528	" June	13, 1905
DeForest	"	1,377,405	" May	10, 1921
Langmuir	"	1,273,626	" July	23, 1918
Marconi	"	627,650	" June	27, 1899
Marconi	"	647,007	" Apr.	10, 1900
Alexanderson	"	1,173,079	" Feb.	22, 1916
Kendall	"	1,216,136	" Feb.	13, 1917
Nichols	"	1,257,381	" Feb.	26, 1918

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2. The publications on which defendant will rely to establish the defense of want of patentable invention, in addition to the patents above enumerated, are:

Pierce	No.	1,127,371	granted Feb.	2, 1915
Richards	"	1,103,688	" July	14, 1914
Langmuir	"	1,282,439	" Oct.	22, 1918

3. The documentary evidence upon which defendant will rely in support of its defense that the patentee was not the original and first inventor but, on the contrary, if the invention is

172 *Defendant's Bill of Particulars*
(Equity No. 50-178).

patentable at all, it was invented first by Irving Langmuir of the General Electric Company of and at Schenectady, New York, is Langmuir Exhibit No. 9, Pages of Langmuir Note-Book No. 458, as reproduced in the record of the United States District Court for the District of Delaware, Equity No. 549, The United States of America and Alexander Meissner, Plaintiffs, vs. DeForest Radio Telephone and Telegraph
173 Company, *et al.*, Defendant's Exhibit Book, Volume 2, pages 442-493, inclusive.

As to Arnold Patent No. 1,465,332:

1. The patents and publications which will be relied upon to establish invalidity of the patent are as follows:

[redacted]ander Bijl	No. 1,350,752	granted Aug. 24, 1920
Colpitts	" 1,13[illegible],384	" Apr. 27, 1915
DeForest	" 1,201,272	" Oct. 17, 1916
174 Alexanderson	" 1,340,101	" May 11, 1920
Meissner	" 1,170,552	" Feb. 8, 1916
White	" 1,195,632	" Aug. 22, 1916
Kendall	" 1,216,136	" Feb. 13, 1917
Logwood	" 1,218,195	" Mar. 6, 1917
Arnold	" 1,129,942	" Mar. 2, 1915
Langmuir	" 1,273,626	" July 23, 1918

2. The publications on which defendant will rely to establish the defense of want of patentable invention, in addition to the patents above enumerated, are:

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Schloemilch, *et al.*	No. 1,087,892	granted Feb.	17, 1914
Nicolson	" 1,255,211	" Feb.	5, 1918
Alexanderson	" 1,419,797	" June	13, 1922
French Patent of Addition	" 13,726/11		
British Patent	" 13,248/14		

3. The documentary evidence upon which the defendant will rely in support of its defense that the patentee was not the original and first inventor are the following patents:

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White	No. 1,617,974	granted Feb.	15, 1927
Kendall	" 1,514,705	" Nov.	11, 1924

GENERAL TALKING PICTURES CORPORATION,
By DARBY & DARBY,
Attorneys for Defendant.

Dated: New York, N. Y.,
November 13, 1933.

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SAMUEL E. DARBY, JR.,
Counsel for Defendant.

178 **Stipulation and Order Amending Answer (Equity No. 50-178).**

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity No. 50-178.

179

It is hereby stipulated that the answer in this cause be amended by the cancellation of subparagraphs (a), (b) and (c) to Paragraph 8, thereof, and the substitution therefor of the following:

180

(a) because the alleged invention of said patents was described in printed publications of the United States and countries foreign to the United States before the alleged invention of said patents or more than two years prior thereto,

(b) because the said patents disclosed no patentable invention or inventions as distinguished from mechanical skill and natural progress of the art in view of the state of the art at the time the alleged inventions were made,

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(c) because the said patentees were not the original and first inventors of the alleged inventions of said patents,

(d) because the claims of the patents in suit are directed to inventions different from the alleged inventions at the time the applications for said patents were filed and that said claims were first made more than two years subsequent to publication of the said inventions, and

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(e) because of double patenting.

HENRY R. ASHTON,
Counsel for Plaintiffs.

New York, N. Y., November 14, 1933.

DARBY & DARBY,
Counsel for Defendant.

New York, N. Y., November 13, 1933.

It is so ordered.

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JNO. C. KNOX,
U. S. D. J.

Dated: 11/16/33

184 **Narrative Statement of the Evidence.**

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. 185 GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-175.
WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. 186 GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-177.
WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-178.

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Before:

HON. MORTIMER W. BYERS,
District Judge.

New York, February 7, 1934;
10:30 o'clock a. m.

APPEARANCES:

CHARLES NEAVE, ESQ., Solicitor for Plaintiffs; Charles Neave, Esq., Henry R. Ashton, Esq., H. A. Pattison, Esq., and E. J. Driscoll, Esq., of Counsel.

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DARBY & DARBY, ESQRS., Solicitors for Defendant; Samuel E. Darby, Jr., Esq., and Ephraim Berliner, Esq., of Counsel.

PRIMA FACIE PROOFS.

Mr. Ashton: I will read paragraphs 1, 2 and 3 of the stipulation of counsel:

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"1. That the above entitled three suits may be tried together as one suit.

"2. That plaintiff, American Telephone and Telegraph Company, is the owner of the legal title to the patents in suit; and that plaintiffs, Western Electric Company and Electrical Research Products, Inc., are licensees under the patents in suit in the sound picture field and are proper parties plaintiff.

"3. That, if otherwise admissible, printed or photostatic copies of United States and foreign

patents may be introduced in evidence at the trial in lieu of the originals or certified copies thereof with the same force and effect as the originals duly proved, and the dates appearing thereon shall be accepted as correct, subject to correction should error appear; and, if otherwise admissible, photostatic copies of printed publications may be introduced in evidence at the trial in lieu of originals thereof, with the same force and effect as originals thereof duly proved;
191 and the dates of publication appearing thereon shall be accepted as correct, subject to correction should error appear."

I offer in evidence copies of the eight patents in suit, and state that the claims relied upon as to each of the patents are as set forth in the diagram attached in the binder of patents.

	Patent No.	*Claims Relied Upon As To Each Part of Defendant's Apparatus.*
Ex. 1-A,	1,231,764	1, 2, 4, 5, 6 and 7 as to A-41, A-36 and PA-39
192 Ex. 1-B,	1,426,754	8 as to A-41
Ex. 1-C,	1,329,283	7, 10 and 13 as to PA-39
Ex. 1-D,	1,349,252	15 as to A-41, A-36 and PA-39
Ex. 1-E,	1,403,475	8, 9 and 10 as to A-41
Ex. 1-F,	1,448,550	1 and 12 as to A-41
Ex. 1-G,	1,465,332	3, 8, 10 and 11 as to A-41, and 1, 3, 5, 10 and 11 as to A-36 and P-32 Power Pack
Ex. 1-H,	1,520,994	1 and 4 as to A-41.

(Marked Plaintiffs' Exhibits No. 1-A, 1-B, 1-C, 1-D, 1-E, 1-F, 1-G and 1-H.)

"4. That within six years prior to filing of the bills of complaint herein and subsequent to the issue of each of the patents in suit, defendant leased to motion picture theatre owners in the United States and installed in such theatre owners' motion picture theatres vacuum tube amplifiers as parts of defendant's talking motion picture reproducing apparatuses or systems, said amplifiers being identified as Types A-41, and 25-A comprising Types A-36 and P-32 Power Pack, and PA-39, which amplifiers were 194 manufactured by The American Transformer Company of Newark, New Jersey, and sold by the latter to the defendant. The circuit and apparatus of each of the said types of amplifiers are correctly illustrated in the diagrammatic drawing annexed hereto."

I offer the drawing referred to in the stipulation, as Plaintiffs' Exhibit No. 2.

(Marked Plaintiffs' Exhibit No. 2.)

195

FRANK N. WATERMAN, called as a witness on behalf of the Plaintiffs, being first duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

Q. Will you state your residence? A. Summit, New Jersey.

Q. And your qualifications to testify in this case?

Mr. Darby: I concede Mr. Waterman's qualifications.

196 *Frank N. Waterman—For Plaintiffs—Direct.*

Q. Will you briefly describe what is involved in a talking motion picture recording system, with particular reference to this diagram of the Western Electric recording system?

Mr. Ashton: I ask that the diagram be marked in evidence Plaintiffs' Exhibit No. 3.

(Marked Plaintiffs' Exhibit No. 3.)

197 A. Outlining very briefly the apparatus involved in recording of motion pictures by reference to Exhibit No. 3, I note that at the left of the diagram there is indicated diagrammatically the camera and the microphones by which the picture was photographed and the sound pick-up, as the expression is. Since it is often not practicable to locate a microphone out of sight of the camera and in such a position that it adequately picks up all of the sound intended, it is not unusual to employ a plurality, two being common, located outside of the angle of view
198 of the camera in positions favoring adequate picking up of the sound.

The Court: When you use the term "picking up," do you mean in effect photographing the sound?

The Witness: No, I mean that the microphone diaphragm is exposed to the sound vibrations, that is, the pressure waves in the air, and is thereby set in motion to produce local currents. It is technical vernacular and merely means that by the microphone, so to speak, the sound, is reproduced. The currents which are pro-

duced in the microphones are exceedingly feeble, so feeble that to undertake to transmit them even in the most carefully shielded conducting systems to the rest of the apparatus would involve risk of the picking up of extraneous noises due to magnetic and electric fields resulting from electrical apparatus, such as the lights employed, that fill the space in the neighborhood. It is, therefore, customary to incorporate in the mounting of the microphone itself and carefully shielded from such extraneous electric and magnetic fields, an amplifier whose function it is to first take the extremely feeble signal and enlarge it to a point where it is large as compared to such disturbances as might get into the circuit due to the passage of the wires from the microphone to the other apparatus.

Sound thus picked up and amplified in the form of electric current is passed on to the mixer in the monitoring room shown just at the right of the studio stage in this diagram. This mixing device is under the control of a monitor. It consists of apparatus of the general nature of the gain control apparatus which we shall consider in one of the patents in suit, and the monitor mixes the product of the two microphones in such manner—that is, each component to such an extent—as to produce a true rendering of what is going on on the stage.

From the monitoring room the current goes to the amplifier room, where it is enormously amplified, and is then passed on to the recording room. In the recording room it is commonly

amplified again, although such amplifiers are not shown in this drawing, and then passes to the recording machines. Ordinarily there are two of these, one recordir · on disc and the other recording on film. Even though the final product is intended to be a record on film, the record is commonly made on a disc, because it affords a means of immediately approving or disapproving the quality of the record that has been made.

In order that the monitor may be guided in a
203 proper mixing and in a proper control of the amount of signal passed on to the recording room, he is provided with a monitoring horn which is shown in the monitoring room. This may take its current either directly from the amplifying room or it may take it from the recording room. It is extremely desirable to be able to know in film recording just what it is that is going on the film. The recording, of course, is done on the film by a variable light. In this particular apparatus indicated here this is accomplished by a light gate which, opening
204 or closing to a greater or less extent, varies the intensity of the illumination striking the film in an exceedingly narrow line.

The film is translucent. Consequently, it is possible to place under it a photoelectric cell to be influenced by the light passing through the film, and thereby to recreate an electric current which can be amplified and sent back to the monitoring room. Thus the monitor has the option of hearing the mixing which he has accomplished coming back directly from the amplifier room or he may hear it as it finally reaches the film, made by the very light which records the signals.

The recording on the disc recorder is done by means of a mechanical printing tool operated electrically by current from the amplifiers, and in case it is to be played back for a visa of the recording it is done by a stylus, very much as in the case of the ordinary phonograph. It is necessary that the recording camera and the recording film machine, the sound recording film machine, be operated in synchronism. The picture is taken on one film, the sound is recorded on another film or on a disc. The same problem 206
of synchronism arises in film recording as in disc recording. It is therefore necessary that the camera and the film recorder as well as the disc recorder should be operated synchronously.

The mechanism for doing this is only indicated diagrammatically by a dotted line leading from the synchronizing mechanism on the camera through to the synchronizing machine in the power room and thence on to the synchronizing apparatus on the film recorder and on the disc recorder. These are rather complex apparatus and we are not concerned with their detail, but 207
by means of this apparatus the synchronism of the three machines is preserved so that they run together with such exactness that when they are later reproduced the sound and the action go together.

Q. Will you now describe briefly the Western Electric reproducing system, for the purpose of illustrating what is involved in the reproduction of talking motion pictures?

Mr. Ashton: I ask that the diagram be received in evidence as Plaintiffs' Exhibit No. 4.

(Marked Plaintiffs' Exhibit No. 4.)

208 *Frank N. Waterman—For Plaintiffs—Direct.*

A. In the reproducing system the signals which have been recorded after enormous amplification upon discs or film are passed through the projecting machines, again converted into current, again enormously amplified and reconverted into sound in the horn back of the motion picture screen. This amplification many times means the passing of the current carrying the signal through a vast amount of apparatus, each amplifying tube having its own associated ap-
209 paratus. If the signal is to be picked up from the disc or from the film, again converted into current and again amplified many times,—the power amplification involved here is in the order of hundreds of millions of times—and have any close resemblance to the original sound, the amplification must be of extreme accuracy. In the picking up of the sound from the record, be it disc or film, the disc-carrying turntable and the film operating apparatus is directly associated with the sound projector. If the disc is used, the two machines, the picture projector and
210 disc, are driven synchronously by a common driving mechanism. If reproduction is to be from film, the separate sound film which was originally produced is printed onto the same film which carries the picture, and the film passes from the film supply reel shown at the top of the diagrammatic illustration of the projector in Exhibit No. 4, down through the picture projector, where the picture only is projected. It then passes down through the sound head where the film passes in front of a suitable light beam formed by an optical system imaging on the film the image of a slit interposed be-

tween the light so that the light falls on the film in an extremely narrow line.

After going through the film the light which is varied in intensity by the variable intensity of the film record is received by what is known as a photoelectric cell. This is a device which depends upon the property of certain substances, particularly the alkali metals, of giving off electrons when light impinges on them. These electrons pass across the space within the bulb and are received on an anode device and constitute 212
an electric current. This electric current is amplified and passed on to the main amplifying system.

Q. Does it have to be amplified immediately? A. Yes.

Q. Why is that? A. For the same reason. Because of its extremely feeble character. It is even more feeble than that generated by the microphone. It must be amplified to such strength of current at the time that incidental pick-ups of extraneous noises coming from electric light wires and the like will not introduce 213
disturbances. Since a reel of film holds only a limited amount of film, it is common in a projecting room to have two projectors, the second reel being set up ready to go when the first runs out.

Q. Will you now describe briefly, for the purpose of the record, the three-electrode vacuum tube, with reference to this diagram which I ask be marked in evidence as Plaintiffs' Exhibit No. 5.

(Marked Plaintiffs' Exhibit No. 5.)

A. The three-element vacuum tube, variously known as the audion, electron tube, thermionic tube or just an amplifier tube, consists, in essence, of a small incandescent lamp bulb containing a filament, particularly selected for its capacity to give off electrons when heated.

It also contains an anode element or plate, marked P in Exhibit 5, which acts as the other terminus of a circuit connected to the tube and marked output. Between these two elements, there
215 is located a grid-like structure ordinarily composed of fine fibres, suitably stretched in grid form, which acts as the control element in the tube, and between which, and the filament or cathode, the input circuit carrying signals to be amplified, are introduced.

I have referred to amplification. The tube has a number of other functions, and is not structurally different, so far as its description goes, for other functions.

The space within the container is exhausted to a very high degree of exhaustion, so that the
216 operation shall not be essentially affected by the presence of gas. Air, of course, being gas. Between the cathode and anode, the filament and plate, there is connected a polarizing battery marked B, and for the purpose of heating the filament, there is a battery marked A. That is common in the art to refer to these two batteries as the B battery and the A battery.

By the Court:

Q. The B battery is connected to what? A. The B battery is connected with its positive terminal to the plate and its negative terminal to the filament.

This wire runs from the negative terminal of the B battery to the negative terminal of the A battery, which is itself directly connected to one leg of the filament circuit.

Q. The negative terminal— A. Is marked with the minus sign.

Q. That is connected directly to the filament, is it? A. That is connected directly to the filament, passing through the negative terminal of the A battery on the way.

218

By Mr. Ashton:

Q. Now, will you say how the vacuum tube operates as an amplifier? A. The heating of the filament causes, by a species of evaporation, the emission of what are known as electrons. There is a great deal of controversy as to what they are, but for our purpose, however, we can consider them merely as particles of negative electricity behaving like small projectiles. They are emitted from the filament with various velocities, sufficient to carry them along only a short dis- 219
tance away from the filament, but in the absence of any other elements, they would exist in the nature of a cloud in the immediate vicinity of the filament. When a positive potential is applied to the plate, there is created within the space and between the plate and the filament what is known as the electrostatic field. The word "field" in that sense, means merely space. When we say electrostatic field, we mean that the space intervening between the terminal, is in some sort of state of stress, that can be demonstrated physically by the use of light powders that will arrange themselves in lines, very much

as iron filings will arrange themselves in lines in the magnetic field. These lines of force in the electrostatic field afford the means of transit for the electrons to the plate, using perhaps a crude figure, that is in substance what happens.

By the Court:

Q. Transit between what? A. Between the filament and the plate. So that when the plate is
221 made positive, the electrons will pass across from the filament to the plate and they will pass in ever increasing numbers up to the point where the field which they themselves create, since they are negative charges, is such as to restrict any further emission from the filament.

The effect of the grid is to modify the electrostatic field. When the grid is positive, for example, due to one-half of an alternating signal wave coming in, it aids the field due to the plate and the number of electrons which pass across is increased, which means that the current in
222 the output circuit increases. When the negative half of the signal wave is imparted to the grid, so that the grid is made more negative, then there is a decrease of the electrons. The grid acts to restrain the electron flow, and the current in the output circuit suffers a decrease. In the absence of a signal, therefore, a certain steady current flows from the battery B to the plate, thence through the filament back to the battery.

I call your Honor's attention to the fact that I have traced that flow of current in the opposite direction to the movement of electrons. That is due to an unfortunate confusion which

exists in the art, because in the earlier days, the assumption was made that the direction of current flow was from the positive to the negative pole. It is quite probable, in view of present-day knowledge that what really happens is that electrons which are negative charges, flow in the reverse direction, but nevertheless the terminology originally employed is still used, so that the procession or swarm of electrons going across from filament to plate is spoken of as the current flow from plate to filament. 224

In the absence of the potential applied to the grid, a given plate battery and a given tube will supply a given current, which current will be constant, but in view of the fact of the grid which I have just been describing it will be clear, I hope, that this otherwise constant current is continually varied, receiving a flow in response to the charges impressed on the grid. Thus there is, in effect, an alternating current more or less corresponding to the current in the input or the voltage in the input circuit impressed on or superposed on the normal direct 225 current in the plate circuit of the tube.

The tube in this capacity is found to act as an amplifier. This may be shown in a simple way, for example, by simply increasing the battery B, say by one volt. If we had a measuring instrument in the tube circuit we would find that the current grows.

If we then applied to the grid a negative voltage until we restored the current to its original value, we would find that the voltage that was necessary to apply to the grid in order to make the same change of output current that was caused by one volt increase in the plate bat-

tery, we would require less voltage applied to the grid, and that ratio is known as the amplifying factor, or for short, the mu of the tube, the ratio of the plate voltage increase required to produce a small increase of plate current and the change of grid voltage, that would be required to annul it.

It follows that when a signal is applied to the grid, a signal alternating current occurs in the output circuit the voltage of which is larger than
227 the voltage of the signal applied to the grid. I have not defined the term "voltage" and the term "current." A current flows in response to a pressure. That pressure may be created by the chemical action of the battery, or by the rotation of a mechanical generator, or in other ways; but the unit in which it is measured is called the volt, and we quite commonly substitute the word "voltage" for pressure. But there is a wealth of terminology governing that same thing. It is often called electromotive force; it is called difference of potential or, for short, simply po-
228 tential—all of those terms meaning so far as we are concerned the same thing. We speak of the voltage or the potential or the electromotive force of a battery, for example.

The current or actual transfer of electricity through the circuit is the quantity of electricity passing a given point per second. In other words, it is a rate of flow of the electricity and is measured in a unit called the ampere. Where we are dealing with small quantities we often refer to a milli-volt or a milli-ampere, meaning a thousandth of a volt. Oftentimes we speak of a micro-ampere, and there might be occasions to refer to micro-amperes, the current of some

tubes being small enough to be most conveniently measured in terms of microamperes, others in terms of milliamperes.

Q. What does "micro-ampere" mean? A. A millionth of an ampere. So when we have a signal voltage applied to the input circuit between the grid and filament it results in a superimposed alternating current in the tube circuit, the voltage of which is higher than that of the signal applied to the input circuit.

Perhaps I ought to make my definitions complete by saying that the need of a pressure in order to force the flow of the current arises from the existence in the circuit of what is broadly known as impedance. There is more than one kind of impedance, and we may find it necessary to speak of reactance resulting from the presence of an induction coil or condenser. There is in all conductors what is known as resistance, which is a property of the conductor itself and which restricts the flow of current. A pressure is required to overcome this resistance or to overcome an impedance and to cause a current to flow.

Q. Can we ordinarily here think of impedance as resistance to the flow of current? A. In nearly all cases I think that will arise in this case we can consider the terms "impedance" and "resistance" as synonymous. Specifically we can consider that is true in the case of the tube, since we are dealing wholly with audio-frequencies. I ought perhaps to define what I mean by that.

The voice acts to create alternate waves of pressure and rarefaction in the air, and one cycle comprises one compression and one rarefaction.

In general a cycle extends from where any phenomenon starts in a given direction until it returns to the same direction. So a period of a sound wave extends from the beginning, say, of one condensation or compression of the air to the beginning of the next, and that would be variously referred to as the period or the cycle. We will speak of the number of such periods occurring in a second as the frequency.

All ordinary sound is a complex of frequencies.
233 The piano note, for example, as I remember it contains some forty-six, or at any rate between forty and fifty, overtones that are necessary to express the particular quality of tone that the piano emits.

Q. Will you now briefly describe the nature of sound waves with reference to these oscillograms of voice currents?

Mr. Ashton: I will ask that these oscillograms of voice currents be received in evidence as Plaintiffs' Exhibit No. 6.

(Marked Plaintiffs' Exhibit No. 6.)

234

A. It is possible to make a current write its own autograph, and that is done with an instrument known as an oscillograph. Exhibit No. 6 represents one continuous length of record which for convenience has been cut up into sections and pasted in order onto a sheet and photographed. The sentence which the oscillogram represents is given on the sheet just under the title, "Joe took father's shoe bench out." The strips have black scale marks, short vertical lines marked under them, the distance from one scale mark to the next being one one-hundredth of a second. Each tenth mark is indicated by the num-

erals 1, 2, 3, 4, et cetera. You will notice that in general the consonants occupy very short intervals of time.

Take the time interval from the beginning of "J" which is just about the beginning of the first vertical line, to the beginning of "o." It is only two one-hundredths of a second, whereas the "o" sound extends down to near the middle of the next line, there being a short pause between the end of the first sound and the beginning of the "t" sound. I call attention to the 236
fact that the consonant sounds in general are composed of extremely high frequencies. This is indicated by the very many wavelets found just following the letter "J," between it and the letter "o." The current alternated, in other words, with very great rapidity.

That is not a single frequency there shown but a composite of many frequencies, in order that the characteristic sound of "J" may appear. Those must be rendered faithfully with respect to all of the essential component frequencies, and the component frequencies must be present in 237
their proper proportioned intensity. One harmonic, for example, may be quite strong, comparable almost with the fundamental; others may be quite feeble. But all are necessary, and it is necessary that the relative intensities should be preserved. If the oscillogram were on a very much larger scale those things would appear more readily.

The vowel sounds are very complex, but their fundamental frequencies are of a much lower order. That is very well illustrated by the letter "o." That very irregular line is in reality composed of a large number of smooth sinuosidal

waves superimposed upon one another in their correct intensity relation and in their correct phase relation. For example, if a given wiggle is to be composed of a fundamental and a second harmonic, the wave will be of quite different shape if it so happens that the second harmonic starts so that one of its peaks agrees with the peak in the fundamental, or whether it does not, whether it is timed in some other relation.

So those various things are taken account of
239 in the formation of the shape of this signal wave, that is indicated. It is interesting to note how extraordinarily complex the sound "th" or the sound that intervenes, the finishing of the "a" leading into the "th" in "father." It gets increasingly complex. Then the "sh" sound in "shoe" is extraordinarily complex. It extends from just to the right of the time interval marked 7 and something over two divisions to the right of the time interval marked 8. Very high frequencies are there illustrated in very complex combinations.

240 Your Honor has doubtless noted in the early radio sets how very very badly the "sh" sounds were often reproduced, because of the inability of the amplifiers to reproduce such a great complexity of sound waves.

Q. Will you now briefly describe and point out the range of frequencies to be reproduced in talking motion pictures, public address systems, et cetera, with reference to this diagram from the magazine "Electronics"?

Mr. Ashton: I will ask that that magazine, "Electronics" be received in evidence as Plaintiffs' Exhibit No. 7.

(Marked Plaintiffs' Exhibit No. 7.)

A. This sheet illustrates the frequencies in the entire useful range, but we are concerned only with that part marked "Audible spectrum" in the lower left hand portion. The limits or human ear sensitivity are there given as from 16 cycles per second to 16,000 cycles per second. Of course, ears differ, and any particular individual might not be able to hear such an extreme range, some might even surpass it; but the 16 to 16,000 is taken as the limits of human sensitivity.

242

The Court: The normal?

The Witness: Yes, the normal limits. The range of the piano is indicated by the keyboard shown at the bottom of the figure, and the various instruments of the band and orchestra are noted by brackets above.

Mr. Ashton: I call your Honor's attention to the statement of the Court of Appeals in the Wallerstein case, beginning at page 2 of the opinion:

"The problem of amplification was to 243
reproduce without distortion the input of the amplifier and its output greatly increased in energy. Speech has been found to be extremely complicated, each of the ordinary sounds being composed of many frequencies which must be accurately reproduced. The range of audible frequencies is from 16 to 16,000 vibrations per second. For sound pictures and public address systems substantially from 30 to 5,000 cycles must be reproduced without distortion in order to give the high quality which is known today. Greater

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power is needed to drive the loudspeakers of these systems than is required for radio or telephone. The lack of faithful reproduction would be so accentuated under certain conditions as to destroy the utility of the systems. The success of sound pictures was due solely to high quality reproduction—that is, without distortion."

245 Q. Now, will you briefly summarize as to each feature of audio amplifiers to which the patents in suit relate? A. The Lowenstein patent, known as the Negative Grid Bias Patent, goes to the organization of the tube and its input circuit, the electrical circumstancing of the grid of the tube being such as to avoid distortions due to the flow of current in the input circuit. The Mathes patent, the Resistance Bias Patent, shows a convenient way of obtaining the grid bias by means of a resistance. Insofar as Claim 8 in suit is concerned, it goes to the location of the resistance in the path of the current which
246 heats the filament.

If you will refer more particularly to Fig. 1, your Honor, the resistance which produces the bias on the grid is shown in Fig. 1 at 9. It is in the circuit of the filament heating current which flows from battery 6, starting at the right hand end of the battery 6 marked plus. The current flows through the filament 3, then through the resistance 9, then through the resistance 15, then through what is known as a choke coil 14, then back to the battery.

Mr. Ashton: I might say, your Honor, that Mr. Waterman in this answer was

going to state briefly the inventions, what they are directed to, and that a little later he is going to discuss each one in detail and actually trace the circuit. I want to call your attention to the fact that he is going to trace through these circuits in detail in answer to specific questions about each patent.

The Witness: The Mathes patent has the advantage that if the battery system of the tube fluctuates, as for example, by 248
charging as illustrated in Fig. 1 of the drawings, the bias is made to vary as the grid current varies, for reasons that I will later explain.

The Arnold Patent 1,329,283, known as the Power Circuit Patent, sets forth a number of discoveries made by Arnold as to the fundamental properties of tubes, and insofar as the claims in issue are concerned is directed to the obtaining of a large power output by an efficient relation between the tube and the circuit into 249
which it is working, while at the same time getting a high degree of fidelity in the result. It is concerned, therefore, with the load device characteristics applied in the output circuit and the internal tube characteristics connected to that output circuit in their relation to one another.

Patent 1,349,252, known as the Straight Line Characteristic Patent, deals with the obtaining of essentially a true reproduction in the output circuit of the voltage actually applied to the grid in the input circuit; whereas the Lowenstein patent, for example, has particularly to do with

avoiding distortion arising in the input circuit largely exterior to the tube; this patent has to do with the arrangement of the external output circuits, to avoid difficulties arising purely within the tube. In other words, briefly the tube is not naturally a faithful repeater. Their problem was to make it repeat faithfully. That is the problem that is dealt with in Patent 1,349,252.

Patent No. 1,403,475 has to do with a situation where a multiple stage amplifier is used. The signal is amplified in one tube and passed on to the second tube. The problem is how to connect the tubes together so that the input of one connects with the output of the other.

By the Court:

Q. Unimpaired? A. Unimpaired, yes. There are various ways of doing that. This patent proposes what is known as the resistance capacity coupling method. More accurately, we should call it the resistance coupling capacity connected, but the phrase is "resistance capacity coupling" and it gives a mode of coupling or associating two tubes, which treats all frequencies alike within a very wide range. All frequencies involved in the sound spectrum, for example, come through substantially equally well with it, without any distortion in the coupling means.

Patent No. 1,448,550 is known as the "definite input impedance" patent. When the line conveying the incoming signal looks at the tube,—to use the common method of expression,—what it sees would depend upon how the tube is being operated, and what happens in the line will be in a measure affected by what the line sees in

looking into the tube. Also the tube has other properties than those which we have heretofore considered, and those which enter into its function as an audio frequency amplifier. It acts in a measure like a small condenser, a condenser being two insulated conductors in which there is capacity between them, in two insulated conductors separated one from the other by a sort of dielectric in which an electrostatic field can be set up.

The tube connected across the input circuit 254
has a certain effect in view of this capacity. They will not necessarily be alike with two different tubes. There is a class of problems, therefore, that arises both in telephone cable work and in public address systems and in talking motion picture amplifiers that grow out of the fact of what the incoming signal line sees when it looks at the tube. To make the input circuit of the tube a constant thing, regardless of change of tubes and to eliminate the factors which may arise out of the capacity of the tube, Arnold puts across the input circuit a resistance 255
selected from the point of view of what the engineer wants to have the line see. It is indicated simply as resistance 6 in the figure.

Patent No. 1,465,332 is the "common battery filter patent" and illustrates the connection and supply of two tubes to and by a single battery. The plate circuit of each tube has to be supplied with a source of voltage and current, which is indicated at 20 in the drawing, and in order that the very much enlarged signal coming out of the said tube may not react back into the first by means of a common connection to the battery, Arnold has organized the particular circuit

there shown that I will later deal with in detail. The problem there was to supply from a single source two or more tubes and with preserving the alternating current separateness while giving them a direct current unit.

Patent No. 1,520,994 goes to the question of the overall gain control of the amplifier. The small signal comes in at one end of the amplifier and the large one—relatively large one goes out at the other end. In order to control to a
257 desirable volume that which goes out from the final output stage, it is desired that some means shall be provided which shall not disturb any of the operating characteristics of the entire apparatus which has to do with fidelity, that is accuracy of reproduction of the signal. This patent is concerned with accomplishing that result in a way that shall not have any deleterious effect on the action of any element or tube or circuit element in the amplifier. Briefly it is done by means of a potentiometer voltage driving off the voltage plate to the grid of the sec-
258 ond tube. The potentiometer resistance is connected across the secondary, 24, of the intermediate transformer, and the variable quantity of the voltage extended in that resistance is applied to the grid, the grid is negatively biased and therefore its control has no effect whatever on the circuits, to disturb their performance.

By Mr. Ashton:

Q. Are these inventions which you have referred to, capable of use in a single amplifier? A. Yes, they commonly are so combined.

Q. Will you now describe very briefly the defendant's circuits with reference to the diagram

Plaintiffs' Exhibit 2? A. Plaintiffs' Exhibit 2 is a purely schematic illustration of the component parts of the defendant's amplifier. The amplifier is built in three units, the parts included in them being indicated by dot-dash lines on the drawing. There is a preliminary or photo-electric cell amplifier A-41; next there is a fader element which is separate and used where there are two projectors, as I have already described.

I think I did not quite finish the answer I was 260
on before lunch. I may say, because of the shortness of the roll of film, it is customary to employ two machines in the projection room, and as these are loaded with film, which overlap, that is to say, the film of the second reel will start before the other finishes.

Mr. Ashton: Note that the witness is referring to Plaintiffs' Exhibit 4.

A. (Continuing.) The fader is used to transfer the signal from one to the other after they
are started and synchronized, so as the fader 261
handle is moved, the sound from one machine gradually dies out and the sound from the other machine begins, so that the audience is not conscious of a change of reel.

The next amplifier in Exhibit 2 is that marked "intermediate amplifier" A-36. It contains only the audio frequency units and the power supply is from the dots indicated below and marked "power pack P-32."

By the Court:

Q. Does that take the place of the batteries? A. That takes the place of the batteries which

are shown connected to the preliminary amplifier A-48. Much higher power and higher voltages are required for this amplifier, and it is convenient, where large power is required to be able to supply the power from an electric socket, and the power pack P-32 is the means for accomplishing that result. So far as we are concerned at the moment, it is the B battery and the A battery combined.

The last amplifier is marked power amplifier
263 PA-39. So-called power tubes are employed in this amplifier and they deliver a very large amount of output power to the loudspeakers, one of which is the stage speaker and the other is the small monitor speaker, by which the monitor, controlling the performance of the amplifier, may tell whether or not he has it adjusted correctly for the proper volume and whether the amplifier is correctly performing in all its parts.

I neglected to refer to the input, which is at the left-hand and shown as a photo-electric cell. This photo-electric cell is mounted in what is
264 called the sound head in each case of the Western Electric projector. The film passes through a suitable gate and the light shines through the gate, on to a sensitive surface of the photo-electric cell. The result is to cause electrons to be given off each unit of light, so as to cause a setting off of electrons, and this electron current must correspond precisely in its character to all the complex characteristics of the sound wave.

The electrons pass to the anode and are passed on through the system progressively amplified until a large power, taken at the final output

circuit, as compared to all but infinitesimal power going into the input of the first stage.

By Mr. Ashton:

Q. The A-41 amplifier at the left is mounted on the machine itself in defendant's arrangement, is it not? A. I so understand. I have not seen the actual projector. It is in the Western Electric. It is ordinarily necessarily so, because the amplification must begin immediately. 266

Q. Where are the intermediate amplifiers and the power amplifiers ordinarily located? A. In an amplifier room supplied for the purpose; sometimes in the projecting room, but not ordinarily there.

Q. On what type of supporting panels? A. They are ordinarily panels put in racks, very much like a radio set, on a very much enlarged scale.

Q. Will you point out as briefly as possible the location of the inventions in the different parts of defendant's amplifier circuit? A. Without going into detail, the Lowenstein invention is illustrated by each of the amplifier tubes in each of the amplifiers, there being means that I will later point out in detail in each tube for providing the negative bias to the grid. 267

The Mathes patent is illustrated in the A-41 amplifier, the resistances R-1 and R-2 being, as I will explain later in detail, the means employed for actually producing the bias.

The Arnold Patent 1,329,283 is illustrated in the amplifier PA-39, in other words, this power circuit pack is illustrated by the power amplifier of the defendant's apparatus.

268 *Frank N. Waterman—For Plaintiffs—Direct.*

The straight line characteristic patent 1,349,252 is illustrated in the tube V-1 of the A-41 amplifier, the tubes V-3 and V-4 and V-5 of the A-36 amplifier, and the tubes V-6 and V-7 of the PA-39 amplifier.

Mr. Ashton: I call your Honor's attention again to the right-hand column of the diagram in the book of the patents, which actually lists the types of amplifiers as to each patent.

269

The Witness: The resistance capacity coupling patent 1,403,475 is illustrated in the coupling means employed between the photo-electric cell and the tube V-1, where extremely minute currents from the photo-electric cell must be amplified with extreme faithfulness in all their characteristics, without any loss of distortion in the circuit, and this coupling is particularly useful for such extremely weak signals.

Patent 1,448,550, the definite input impedance patent is illustrated in the tube V-2, that is to

270 say, the input circuit of the tube V-2 of the A-41 amplifier.

The common battery and filter patent 1,465,332 is illustrated in the A-41 amplifier, where both stages are supplied by common batteries A and B^1, filaments being supplied from the battery A to the plates from the battery B^1.

It is also illustrated in the A-36 amplifier where the power supply is from the power pack P-32, plate circuits of both of the tubes,—of three of the tubes,—there being three tubes in this amplifier, two in the last stage, under special arrangement which I will describe later, being supplied by the power pack P-32.

In the amplifier P-39 there is only one stage, although there are two tubes, they act as a single stage, and this patent therefore does not apply to the A-39 amplifier.

The gain control patent 1,520,994 is illustrated in the input circuit of the second stage, namely the tube V-2 in amplifier A-41, where the desired proportion of the incoming signal is selected and taken to the grid as I will more fully explain later.

Q. Now, will you state just generally some of 272
the uses to which these inventions have been put, and in particular with reference to different fields of use? A. They have been extensively used in wire telephony and radio telephony; also in public address systems. They are of vital importance to electrical recording, whether on discs or on film, and they are equally essential in the reproduction of such records for the purpose of talking motion pictures. Of course, there are many other specific uses, particularly laboratory uses where they are important, but those are the major ones. 273

Mr. Ashton: I woud like to suggest, your Honor, if there is no objection, that Mr. Waterman's testimony be interrupted at this point for the purpose of putting on several fact witnesses, who will testify as to the use of these inventions in particular situations, starting with the transcontinental line in 1913.

Mr. Darby: I have no objection.

(Witness temporarily excused.)

274 *Burton W. Kendall—For Plaintiffs—Direct.*

BURTON W. KENDALL, called as a witness on behalf of the plaintiffs, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Burton Warren Kendall; I reside at 74 South Munn Avenue, East Orange, New Jersey. I am employed by the Bell Telephone
275 Laboratories as toll systems engineer. I entered the employ of the Western Electric Company February 5, 1913, in the research branch of the engineering department.

Q. State very briefly what was your higher educational experience prior to your employment by the Western Electric Company? A. I was graduated from—

Mr. Darby: Unless there is some particular reason,—I don't know whether this witness is being qualified as an expert—

276 Mr. Ashton: No, he is not.

Mr. Darby: I know who Dr. Kendall is, and I do not require any such qualifications.

Mr. Ashton: Very well, I will withdraw the question, if you wish.

By Mr. Ashton:

Dr. Arnold was one of the supervisors in the research branch when I was employed by the Western Electric Company. That is the branch which I entered. I was placed by Dr. Arnold on the work of repeater development.

Q. I show you a tracing number ES160,131, dated December 8th, 1914, entitled, "Vacuum Tube Repeater Transcontinental Circuit," which I ask be identified as Plaintiffs' Exhibit 8 for identification.

(Marked Plaintiffs' Exhibit No. 8 for identification.)

Mr. Ashton: Also tracing ES160,132, dated December 8th, 1914, and also entitled, "Vacuum Tube Repeater Trans- 278
continental Circuit," which I ask to be marked for identification as Plaintiffs' Exhibit 9.

(Marked Plaintiffs' Exhibit No. 9 for identification.)

Mr. Darby: May I inquire the relevancy of this material?

The Court: It is not offered in evidence yet; it is only marked for identification.

Mr. Darby: I know, but the witness is being questioned about it.

Mr. Ashton: I will be very glad to state. 279
The purpose of this part of Mr. Kendall's testimony is to show the use of some of these inventions in connection with the opening of the transcontinental line in January, 1915, and which we want to put on the record.

Mr. Darby: Very well. I haven't any objection to using it for that purpose, but to save you time, I am perfectly willing to stipulate that by September of 1915 every one of the inventions, at least by September, 1915,—every one of the inventions purporting to be covered by the

claims here in issue of each of the patents in suit, was in commercial, successful public use, by at least 1915.

Mr. Ashton: We will run through it very briefly, your Honor. It won't take but a short time to cover those uses and for the purposes of the record, I think it should be stated by the witness.

The Court: Do you think Mr. Darby looks like a Greek bearing gifts?

281 Mr. Ashton: No, I don't think that, but under the circumstances, I think we should have it in the testimony.

The Court: As long as you are going to pay for the testimony, I don't see why you should not have it.

Mr. Darby: As I understand, Mr. Ashton, you are not introducing it for the purpose of carrying the date of the invention back, or anything like that?

Mr. Ashton: Not as to this part of the deposition.

282 Mr. Darby: Very well.

The Court: Is there any objection to receiving these in evidence now, Mr. Darby?

Mr. Darby: No, your Honor.

The Court: The reason I ask is because I do not wish to permit the witness to testify to the contents of an exhibit which is simply marked for identification. If there is no objection, why not have it marked now?

Mr. Darby: I have no objection, and I am perfectly willing to accept, without further proof, these papers as to their accuracy and authenticity, on the under-

standing, of course, that it is not being used for the purpose of carrying the date of the invention back.

Mr. Ashton: I offer the two drawings in evidence as Plaintiffs' Exhibits 8 and 9.

(Drawing ES160,131 marked Plaintiffs' Exhibit No. 8; drawing ES160,132 marked Plaintiffs' Exhibit No. 9.)

The Witness: No. 160,131 is the circuit of the right-hand of two boxes, which together, made 284
up a two-way telephone repeater and No. 160,132 is the circuit of the other box, the left-hand box. These circuits were used in about December, 1914, in the making up of these repeaters for the transcontinental line and are circuits of the repeaters as used at the time it was opened. The line was opened in the latter part of January, 1915.

The Bell System has maintained commercial transcontinental service continuously since the opening of the transcontinental line in January, 1915, with the possible exception of line breaks, 285
due to storms. As to whether I had anything to do with the opening of the transcontinental line in 1915, the organization was in my department, and was largely responsible for wiring up these repeaters, and I was at the time the transcontinental line was opened at Omaha and in charge of one of those repeater stations. Repeaters were provided at Pittsburgh, Chicago, Omaha, Denver, Salt Lake City, Winnemucca, Nevada.

These repeater stations are referred to in this article of the San Francisco Bulletin of January 15, 1915, in the second column, down near the

bottom it says there are five amplifying stations en route at which the voices are repeated, and so on.

(Offered and marked Plaintiffs' Exhibit No. 10.)

Mr. Ashton: I also offer and ask that it be marked as part of the same exhibit 10, articles in the New York Times of January 26, 1915; San Francisco Chronicle,
287 January 27, 1915, and the Morning Tribune of January 26, 1915.

Mr. Darby: May I ask the purpose of these documents, Mr. Ashton?

Mr. Ashton: They establish the time when the transcontinental line was opened in January, 1915.

Mr. Darby: That is not disputed.

Mr. Ashton: And show that the stations were located at those various places.

Mr. Darby: What does that establish? You were not willing to accept my con-
288 cession that these inventions were used, and you said you wanted to put your proof in, but I don't think this is proof of that at all.

The Court: This is only proof that newspapers said so, and the witness is telling us the fact.

Mr. Darby: It is apparently put in as atmosphere, to show what a wonderful thing this transcontinental telephone was. We will all agree that it is a marvelous thing—

The Court: Are you objecting, or just making a statement?

Mr. Darby: Yes, sir, I am objecting, your Honor, because this is going to be a very heavy case and I want to keep the record down as much as possible.

The Court: One more exhibit won't make much difference, will it?

Mr. Darby: One exhibit will not, but this may be used as a precedent and may open the door to let many more in.

The Court: I will overrule the objection; you may have an exception. 290

(Marked as part of Plaintiffs' Exhibit No. 10.)

By Mr. Ashton:

Referring to the drawings Exhibits 8 and 9, the tube marked No. 1 on ES160,131, Exhibit 8, is a voltage amplifying tube used in the transcontinental repeater circuit. This tube is like the tube to which I have just referred as being used in the circuit of Plaintiffs' Exhibit 8.

291

Mr. Ashton: I offer the tube in evidence as Plaintiffs' Exhibit No. 11.

(Marked Plaintiffs' Exhibit No. 11.)

The type of tube used in the second stage of the transcontinental repeater was a tube built to deliver a larger current. We call it M type tube. The internal construction of this tube is that of the type M tube.

Mr. Ashton: I offer the tube last referred to by the witness in evidence, as Plaintiffs' Exhibit 12.

(Marked Plaintiffs' Exhibit No. 12.)

292 *Burton W. Kendall—For Plaintiffs—Direct.*

By Mr. Ashton:

The internal impedance of the M tube and that of the circuit to which it went were equal or as nearly as we could make them so. The alternating current portion of the output current varied linearly with the alternating input voltage. As to the values of the resistance of the input circuits of each of the tubes in the transcontinental circuits, the tube marked No. 1 on
293 drawing No. 160,131 had its input circuit, that is grid to filament connected across a resistance of about 500 ohms. The tube marked No. 2 had its input circuit connected across a portion of the resistance of 600,000 ohms total, and the connection in the second one is adjustable.

A negative grid bias was used on each of the tubes. In earlier work we made experimental tests of a single tube repeater circuit with a positive bias on the grid and without a gain control in the input circuit. From early in the Fall of 1913 through to the latter part of February
294 or early in March, 1914.

As to the circumstances under which we changed from using a positive bias to using a negative bias, and from not using a gain control to using a gain control, we had worked for some months without great success with a positive bias and with gain control not provided through a potentiometer arrangement in the input circuit, and early in March, 1914, discussing the matter with Dr. Arnold he suggested to me that we change the polarity of the C battery which we were using—the C battery being the battery applied between the filament and grid—and from positive on the grid to place the negative side of the battery on

the grid. He further suggested at the same time that another trouble that we had regarding the input impedance of the tube would be met under those conditions by stretching across the high side of the transformer a resistance equal to that resistance into which the transformer was built to work; and, further, that the matter of adjustment of the gain of the amplification—that is, given by the tube—could then readily be attained by making the grid contact adjustable along the potentiometer so as to take off a larger 296
proportion of the voltage across that resistance. That was the beginning of March, 1914. Before Dr. Arnold made these suggestions to me, we had been using other methods to adjust the amplification of the repeater. At one time we were adjusting the amplification by varying the number of cells in the plate battery. Later we kept the number of cells in the plate battery fixed, but put in a series resistance and a shunt resistanee, adjustable in the circuit, beyond the output transformer.

This notebook marked No. 25, B. W. Kendall 297
is a notebook which was kept by me. On page 68 there is the note "Pgh," which was brief for Pittsburgh, one of the stations where we were experimenting; dated "3/10/14," and the stafement which I might as well quote is: "Arrived, to put in St'd B audions, with higher B current, —cells"—or negative cells—"in C ckt, high fixt resistance across high side of input tr."—transformer—"adjusting gain by tapping off across part of this for the grid."

Mr. Ashton: I offer page 88 of the witness' notebook in evidence as Plaintiffs'

Exhibit No. 13, and ask that a copy be substituted.

(Marked Plaintiffs' Exhibit No. 13.)

This notebook No. 42 is one that was kept in Philadelphia, the entries being largely by one of the men in my organization who was stationed there observing the operation of the repeaters. The writing is in a great many cases of someone other than myself. It is carbon copies of reports which he sent in to me. This notebook was
299 kept under my direction. Frequently my writing is in there, when I happened to be in Philadelphia; but most of the writing is Mr. Thompson's.

Mr. Darby: No objection.

The Witness: This record under date "March 23, 1914, Monday," states that No. 9, which refers, I believe, to the New York-Baltimore circuit numbered 9—was on the audion circuit, and further states, "This is the first day of service of new audion and modified audion circuit." The circuit shown below shows these features which
300 I have mentioned, that Dr. Arnold told me about a few days before. That is, the input transformer closed through a resistance. A portion of the voltage across this resistance tapped off by a movable contact to apply to the grid, and between this tapping off and the grid a battery poled with a negative toward the grid. I saw the circuits, including this gain control, in service in Pittsburgh experimentally on the 10th or 11th of March, and at Philadelphia on the 23rd of March, 1914.

Mr. Ashton: I offer the page of the notebook, No. 42, which has been referred

to by the witness, in evidence as Plaintiffs' Exhibit No. 14, and ask that a copy be substituted.

(Marked Plaintiffs' Exhibit No. 14.)

The modifications which I have referred to, including a negative bias on the grid and a gain control in the input circuit, became a standard on repeater circuits. They were widely used after this time on repeater circuits throughout the telephone plant. The repeaters which were shown on 302
this sketch which was put in evidence remained in service in general in the Transcontinental line until about 1920. Single tube repeaters were also used at about the time of the opening of the Transcontinental line. Circuits were opened for the Pacific Telephone and Telegraph Company, connecting through from San Francisco to Los Angeles, with the repeater at San Luis Obispo in one direction, and also connecting north with three repeaters in the circuit. The single tube repeater circuits had M-type tubes like Exhibit No. 12, and also a resistance bridged 303
across the input. One thing about Exhibit No. 12, the M-type tube w .s ordinarily made up with a base. The repeaters did use these M-tubes, and they had a resistance bridged across the input. The impedance of the plate circuit of the type M tube as used in these repeaters was of the same order as the impedance of the work circuit.

The negative voltage on the grid circuit has been used, I believe, on all subsequent repeaters. The use of a resistance across the input circuit to give a definite impedance has been used on at least most of the repeaters. The tapping off

of a portion of the voltage across this resistance has been used on most of the repeaters, and the matching of tube output impedance to the impedance of the work circuit has been used, I believe on all of the repeaters.

The opening of the Transcontinental line in January, 1915, attracted a very considerable public attention.

Cross Examination by Mr. Darby:

305

I am familiar, in general, with the subject matter of the eight patents in suit. I know, in a general way, what the invention is of each of those patents. I think that the subject matter of each of those patents has been used by the Telephone Company in its telephone lines commercially since at least as early as September, 1915. And, I think, they have been used continuously since that time. They have been used in the ordinary commercial business of the Telephone Company in transmitting messages for pay between distant stations since September, 1915.

306

Before we opened the Transcontinental line we had a repeater station at Philadelphia, sometimes on the New York-Washington circuits and sometimes on the New York-Baltimore circuits. Repeaters at Philadelphia for either of those. Vacuum tubes as amplifiers were used on an experimental basis as amplifiers at this Philadelphia repeater station. The repeater sets were not sold commercially. The repeater set was just a breadboard type of thing, just stuff wired up on an entirely laboratory basis, and was not—. The traffic that went through that re-

peater was paid for right in New York, or paid for in Washington or Baltimore. In other words, they were used in the commercial transmission of telephone messages of your subscribers. About the earliest vacuum tube repeater at Philadelphia was about October, 1913. We employed a negative bias on the grid circuit, the vacuum tube repeater in this Philadelphia installation. After the date that was brought out in connection with that Philadelphia notebook, March 23, 1914. It was put in that morning. That repeater set was 308
not changed back to positive bias. The repeater set was not in continuous operation, however. From that date on, I am prepared to say—that is, in March, 1914,—that the employment of a negative bias became a standard practice of our company. In our earlier repeaters the negative bias was obtained by a separate C battery. I think we did, in some repeaters considerably later, depart from the practice of using a separate source of current—that is, separate from our A battery source—for imparting a negative bias on the grid. I do not know just what time that came 309
in. I know the subject matter that is referred to by the name Definite Input Impedance of one of the Arnold patents in suit. In our Transcontinental equipment we employed the definite input impedance arrangement in 1915, and have continued to use it since.

Re-direct Examination by Mr. Ashton:

I stated that the repeater circuits that we were using in March, 1914, were sometimes used for paid conversations. They were continuously under the supervision of one of the members of

the Research Department while they were in the circuit. When he wished to leave to go out for lunch or to go home at night, a slide switch was thrown over, which threw the circuit over onto the Shreeve repeaters, which were also equipped at this point, and left on those during his absence. As to why this was done, the repeaters were in the circuit for the purpose of experimental observation on their operation on the circuit. The Shreeve mechanical repeater was
311 being used regularly at that time in those circuits, in the New York to Washington and New York to Baltimore.

Re-cross Examination by Mr. Darby:

As to whether that situation prevailed insofar as the Transcontinental service is concerned, for a little time after the Transcontinental line was opened, for commercial messages, which was the latter part of January, 1915, engineers from the Research Department were out with the repeat-
312 ers observing their operation. I was among them for some weeks myself. We had engineers at all the repeater stations for a brief time. A matter, I presume, of from two weeks to perhaps two months.

Q. So that by the end of March, 1915, the equipment was all O. K., and it has gone on happily ever since in its faithful operation, carrying paid messages from San Francisco to New York; is that right? A. Yes.

LLOYD ESPENSCHIED, called as a witness on behalf of the plaintiffs, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Lloyd Espenschied. I reside at 99 Newbold Place, Kew Gardens, New York City. My present occupation is high frequency transmission engineer, American Telephone and Telegraph Company. I was employed by the American Telephone and Telegraph Company in 1915 as a development engineer. 314

Radio telephone tests were conducted by the American Telephone and Telegraph Company and Western Electric Company in 1915. They were tests of long distance telephony, representing an attempt to project the voice across the oceans for the first time. The transmitter was located at Arlington, Virginia, just outside of Washington. The receiving stations were at New York, San Francisco, California, San 315 Diego, Panama Canal Zone, Hawaii and Paris, France. In New York, Mr. Englund was in charge of the station; at Mare Island, San Francisco, Mr. Hartley; at San Diego, Mr. W. Wilson; at Darien, Canal Zone, R. H. Wilson, his brother; at Paris, France, Mr. Shreeve and Mr. Curtis; and at Honolulu, Hawaii, myself.

This paper dated May 26, 1915, is a description of the receiving apparatus employed at each of these points, a copy of which description I took with me to Hawaii. This paper was prepared in order that each of these engineers might have full information concerning the ap-

316 *Lloyd Espenschied—For Plaintiffs—Direct.*

paratus he was to use. It was given to the various men at the receiving stations.

I arrived in Honolulu in June, 1915.

This is a photograph of a radio receiving set, identical with the one which I employed in Hawaii.

Mr. Ashton: I offer the photograph in evidence as Plaintiffs' Exhibit 15.

Mr. Darby: I object to it as irrelevant
317 and immaterial.

Mr. Ashton: It is a picture of the receiver, your Honor, which this witness operated.

The Court: Objection overruled and exception.

(Marked Plaintiffs' Exhibit No. 15.)

The blue print ES160355, dated May 24, 1915, attached to the Wilson memorandum is a correct circuit diagram of the receiver which I operated at Honolulu. I received with my re-
318 ceiver at Honolulu wireless messages broadcast from Arlington, Virginia, in September, October and November, 1915.

At the left in the diagram is the antenna conveying the incoming signals, which connects through coil A to the ground. To the right are five vacuum tube stages constituting the detector and amplifying stages of the receiving set. The first stage is a high frequency amplifier; the second stage a detector or rectifier which converts the high frequency currents into voice frequency currents; and the next three stages are voice frequency or audio frequency amplifying stages.

The so-called M-type vacuum tubes, such as Plaintiffs' Exhibit No. 12, were used in the audio frequency amplifier in the push-pull stage.

In the 1915 receiver, the output impedance of the third stage is substantially the same as the input to the transformer marked G. Likewise, the output of the fourth stage is substantially the same as the input transformer of the final stage.

The Wilson memorandum contains a reference to this on page 7 in the first paragraph. 320
The output of the two audio frequency amplifier tubes was approximately linear, because the quality I received was good.

The 1915 receiver contained a resistance capacity coupling between the second and third stages. The output of the second stage terminated in a high resistance; I believe it was the order of 600,000 ohms. Across that resistance was taken a connection through a condenser, of about 1 microfarad leading into the next stage, which began with a similar high resistance connected across the input or grid 321
circuit of that stage. This is referred to in the fourth paragraph on page 6 of the memorandum. I might correct the 600,000 ohms which I mentioned, to 400,000 ohms, which I note is the figure given. Some of the stages of the 1915 receiver had a resistance in shunt in the input circuit. Those resistances are given and referred to on pages 3 and 4 of the circuit specifications attached to the memorandum.

There was a variable potentiometer indicated as H in the input circuit of the second audio stage of the 1915 receivers for adjusting the portion of the resistance which is effective in the

input circuit. This is on drawing ES160355. The adjustability is also referred to on page 7 of the memorandum. This was for the purpose of controlling the loudness of the output of the receiver. In receiving signals at Honolulu I made adjustments for that purpose of the resistance H in the drawing. That is, for the purpose of adjusting the loudness of the loudspeaker output or headphone output in the case of using the headphones.

323 The 1915 receiver had a common plate supply for the first stage, the high frequency amplifier, and the second stage, the detector, had in common the B battery marked D. An additional battery shown to the right of D was added to the second stage, but the first portion marked D was common to the two. And, similarly, the third and fourth stages had a common B battery as shown. The common plate supply is referred to on page 2, 4th paragraph, and also on page 4 of the memorandum. The statement that begins, "The connections of the plate cir-

324 cuit."

At first, which was during the summer static season, I was unable to receive the signals at Honolulu but as the natural conditions improved, in the Fall, I received them very well. This tube looks like the D-tube used as the detector tube, I believe it was.

Mr. Ashton: I offer the D-type tube in evidence as Plaintiffs' Exhibit No. 16.

(Marked Plaintiffs' Exhibit No. 16.)

On October 22, 1915, I sent to New York from Honolulu a cable reporting successful reception,

and directed to the American Telephone and Telegraph Company, reading: "Heard well entire schedule." This referred to the schedule of tests. "Hello Shreeve." This is the quotation of what I heard: "Hello Shreeve. This is Webb talking." Then I went on and said, "Voice easily recognized." I am referring to refresh my recollection as to the exact wording of this cablegram to a copy of a newspaper article which appeared in the New York Times, Friday, October 22, 1915. 326

Mr. Ashton: I now ask your Honor if you will receive the memorandum, the Wilson memorandum which was withdrawn and which I now offer again.

Mr. Darby: In view of the testimony of the witness, if your Honor please, I have no objection to the offer of that particular memorandum, but I accept the witness's statement as to everything he said in connection with it. I have no reason for questioning it, and I think under your 327 Honor's previous ruling letting this evidence go in, that diagram would be admissible, I do not see any necessity for the rest of the material, because there is nothing contested about it.

Mr. Ashton: In order to expedite it I did not have the witness quote from the memorandum at the various places that the patents are referred to. This memorandum has been in a number of cases, patent suits in this District, your Honor; it is in a number of records. I think that it ought to be received, because it explains

the whole receiver which the witness has talked about, and makes the record intelligible.

Mr. Darby: If I may say just one final word, your Honor, and then I will sit down. The fact that this document has been admitted in other cases, where it was perhaps admissible, is no reason why it should be admitted here.

Mr. Ashton: On exactly the same proposition.

329

Mr. Darby: I do not know anything about it, and I think this case is going to be disposed of on the admissibility of evidence presented to this Court. There is no dispute that the witness has stated as a fact what it incorporated. Mr. Ashton has asked him is that also referred to in the memorandum, and he said yes; but that does not add anything to the witness's positive testimony, which I do not question.

330

The Court: I will allow it.

Mr. Darby: Your Honor will allow me an exception.

The Court: Yes.

(Marked Plaintiffs' Exhibit No. 17.)

Cross Examination by Mr. Darby:

I don't know what became of this wireless telephone that was used at the different stations. I sent my own back to New York, to the laboratories. I myself was not physically located in the laboratories, so I lost sight of it. No commercial stations were established at that particular time at any one or more of these

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various points where wireless telephone business was carried on; but this was really the begin- There was activity following this, for the Government, which became very considerable durning of radio telephony as we know it today. ing the war, and it was not until after the war that radio telephony became a commercial thing. This activity with the Government started before 1918, I believe starting in 1916. We started making tests for the Navy of radio telephony, and that work continued, as I recall it, right along, and of course burst into more or less flame during the war.

332

The Telephone Company of the Western Electric Company to my knowledge manufactured radio telephone equipment for the Government, especially aeroplane radio telephone apparatus during the war. I do not happen to know what was the earliest time that we manufactured equipment for the Government of this wireless telephone nature. It would be in that same general period. I do not know the exact time. Between 1916 and 1918. I do not know enough about the detail circuits to know whether that equipment likewise incorporates these various features that I have referred to. I mean the detail circuits of the equipment sold the Government. I have every reason to believe that many of these features were incorporated, because they continued on in the art thereafter. The equipment sold to the Government was with vacuum tube amplifiers, of course. Wherever a vacuum tube amplifier is employed you encounter problems of distortion.

333

This work done with wireless telephony was done about the same time, as I recall it, as the

installation of the Transcontinental telephone service. The Transcontinental line was opened at the beginning of 1915, and the beginning of these tests was approximately the same time. By that I mean we had preparatory tests over shorter distances ahead of these tests. The tests concerning which I have testified, transmitting to Honolulu started really in May and June, 1915, and I believe our Transcontinental line was in commercial service in January, 1915,
335 according to the testimony that Mr. Kendall gave yesterday.

The Telephone Company is not directly the manufacturing concern. The Western Electric Company is—represents that function. The Western Electric Company manufactures the equipment and sells it to the Telephone Company for its commercial use—that is, the equipment in general. The equipment that was employed in these Honolulu tests was made in the laboratories of the Western Electric Company. The Western Electric Company likewise made
336 the apparatus that was used in our Transcontinental telephone service as a part of their laboratory facilities. Neither that apparatus nor that first experimented with on the line was commercial apparatus, you appreciate. I am referring to the experimental service between New York and Washington.

Q. But when you established your Transcontinental service in the early part of 1915 and used it for the commercial transmission and reception of telephone messages for pay, that was commercial apparatus, wasn't it? A. I was not sufficiently closely in contact with it to know just what its status was.

Q. Were you sufficiently closely in contact to know that the Western Electric Company manufactured that equipment with the knowledge of the American Telephone and Telegraph Company? A. No, I do not know.

RAYMOND A. HEISING, called as a witness on behalf of the plaintiffs, having been duly sworn, testified as follows: 338

Direct Examination by Mr. Ashton:

My name is Raymond A. Heising. I reside at 232 Oak Ridge Avenue, Summit, New Jersey. I first entered the employ of the Western Electric Company in July, 1914, in the research department. I was responsible for the design of the electrical circuits and the construction of much of the apparatus which was used in the radio transmitter station at Arlington, near Washington for the 1915 radio telephone test. 339

This memorandum and drawing and photographs attached thereto were compiled by myself.

A common plate supply was used for two successive stages, known as the modulator and the first amplifier in the radio telephone transmitter.

The power amplifier represented on the right, consists of a large number of tubes operated in parallel. We used as high as 550 tubes in parallel at one time. They got their plate supply from the generator located nearby, marked 600 volts. The plate circuits were connected in parallel and

connected to the oscillation transformer, which delivered the power to the antenna. We wished to get as much power as possible in these tests. The only generator available at Arlington was the 600-volt generator, and the amount of power which we could get out of a single tube operating on 600 volts was, of course, determined by the voltage. We therefore used as many tubes in parallel as we were able to construct, so as to get into the antenna a power
341 equal to the sum total of the power delivered by the various tubes.

At times, we made the impedance of the load equal to that of the tubes in parallel. Later, after I had measured the antenna resistance and determined that better quality would be secured by coupling closer, the impedance attached to the tubes was made somewhat higher than the impedance of the tubes in parallel.

Negative grid bias was used in each case of the power amplifiers. It is represented by a battery marked 175 volts Ec.

342 Operation of the Arlington transmitter operated for the 1915 tests began the first few days in July, and continued most of the time with two or more tests daily until October, 1915.

This photograph entitled "Power Tube" is of one of the power tubes used in the transmitter. The photograph was taken against the outside of the building in which the equipment was housed. My memorandum correctly describes the other photographs attached to it.

This is a tube of the same general character as the power tubes used in the transmitter. It is constructed with the electrical characteristics, with the plate filament and grid construc-

tion and spacings which were used in those power tubes, and no doubt the same sized glass envelope, but the manner of spacing and separating the elements inside is not identical. Some of the tubes used in the transmitter had bases, as is shown in the photograph of the power tube. Some of them did not have bases, but were used in the form in which this one actually occurs. This particular tube was made about 1916. The power tubes in Arlington of the same kind were called type W tubes. The tube which I have been 344
looking at is a type W tube.

Mr. Ashton: I offer the tube in evidence as Plaintiffs' Exhibit No. 18.

Mr. Darby: Objected to as irrelevant and immaterial.

The Court: Objection overruled and exception.

(Marked Plaintiffs' Exhibit No. 18.)

By Mr. Ashton:

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The memorandum to which I have been referring was prepared November 19, 1930, by me for the purpose of making a permanent record of the photographs, circuits, and so on at that time, 1915.

Mr. Ashton: I offer the memorandum and photographs in evidence as Plaintiffs' Exhibit 19.

Mr. Darby: I object to that as irrelevant and immaterial,—not having any bearing on any issue of the case, in view of my statement that I have no occasion to ques-

tion any of the facts stated by the witness in this examination.

The Court: Objection overruled and exception.

(Marked Plaintiffs' Exhibit No. 19.)

The photograph marked "Power Tubes" was taken in 1915, during the course of the operation of the radio transmitter. It shows the type W tube as actually used.

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Cross Examination by Mr. Darby:

At the time that I designed this equipment for use at Arlington, I believe it was standard practice with us in our commercial apparatus employing more than one vacuum tube, to use a common source of current for the plate electrodes for the tube. I do not believe I ever used the positive bias, and I heard no talk about that. I heard Mr. Kendall testify yesterday. That is the first I heard that they used positive bias.

348 When I first put a bias on the grid, I did that by including in the circuit a connection between the grid and the filament a small battery. I think it probably expresses it to say that when we used a negative bias by means of a battery, we merely would break the line or conductor from the grid to the filament and insert a battery in there. And whether or not a negative or a positive bias was put upon the grid would depend upon whether or not the connection leading directly to the grid was connected to the positive terminal or the negative terminal of a battery. So that in connecting a battery between the grid and filament circuit of an audion tube, you had

one of two possible connections, either connecting the grid to the positive terminal of a battery or to the negative terminal of a battery.

Re-direct Examination by Mr. Ashton:

I said I came with the Western Electric Company in July, 1914.

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FRANK N. WATERMAN, resumed:

Direct Examination by Mr. Ashton (Continued):

Q. Now, will you take up the Lowenstein patent? A. The Lowenstein patent goes to the provision for an audion tube of a means for biasing the grid to a potential ultra-negative with respect to the filament. That is to say, the grid is given a potential relative to the filament more negative than any part of the filament. 351

The invention is described in connection with a telephone circuit, and the upper part of the figure of the drawing shows the ordinary local wiring telephone station.

When the telephone is on the hook 3 shown at the left, the circuits 7 and 11 are broken and the only circuit existing through the system is that through the bell 4 at the right, and the condenser 5. This, as the patent explains, is due to resonating with the ringing frequency, and, therefore, having a comparatively low impedance to the ringing current coming in. When the receiver is taken from the hook, the hook 3 rises

and the circuit is closed at 7, so that the incoming line 1 may be traced through the primary of the transformer 6, thence through the hook 7, thence through the microphone 8 and out on the line 2. A secondary 9 of the transformer connects through the contact 11 also closed when the receiver was taken off from the hook and its circuit goes through the coil 12, which, in the ordinary receiving station is the telephone it-
353 self; thence through the winding 9 and through the condenser 5 to the line 2.

To connect the audion to the line, Lowenstein replaces the telephone by a transformer whose primary 12 is connected in place of the telephone, and to secondary 13 is connected the input circuit of the audion, one end going to the grid 18 and the other end going in directly to the filament as in the diagram Exhibit 5, I believe, going to the negative end of a battery.

The tube is provided with a heating battery 19 adjustable for correct temperature of the fila-
354 ment by resistance 20. From this battery 19, the current flows to the resistance through the portion thereof that is included, as indicated by the arrow, thence through the filament 16 and back to a battery. The plate circuit of this tube may be traced from the battery 21, the adjustable point being indicated so the number of cells may be varied through the receiver. The specification states a transformer primary, in case that is used, as shown, to the plate; thence the current flows to the filament and back to the battery 21. Battery 21 is shown as a single group of cells, and the connection of the filament and the plate are indicated as adjustably connected

so that the plate voltage and the grid voltage may be adjusted.

The effect of putting on the negative bias is to introduce into the electrostatic field otherwise existing between plate 17 and the filament 16, what we might call a low spot. It is made negative with respect to the filament, whereas the plate is strongly positive with respect to the filament.

Before going into further description of the 356
effects produced, I will refer to the specification. At line 11, page 1, Lowenstein points out that his object is "to provide a relay by means of which the relation of the potential differences of the complex incoming speech current is well maintained in the telephone receiver so that the sound reproduced by the receiver diaphragm will be composed of waves of practically the same frequencies as impinge upon the transmitter diaphragm."

What he says he considers most important is
that these various frequencies will have about 357
the same relative amplitudes as the original sound waves actuating the transmitter. The result being freedom from distortion and intelligibility of speech.

He then points out that when a line carries current, a current is drawn from the line to operate a receiver, distortions occur as a result of voltage losses occurring in the line, as the result of the flow of the current.

He points that if the line can be operated without the relay device drawing current from it but a relay using it responds to the terminal voltage of the line and accurate reproduction can be ef-

fected. Without reading all the description, he says, beginning at line 50: "Therefore a relay apparatus which functions according to terminal voltages is well adapted for the production of receiver operating currents of the desired absolute strengths and in the relative strengths necessary for the successful operation of the telephone receiver."

Q. Is that what the Court of Appeals was re-
359 ferring to in the opinion where it said: "This invention consisted essentially in the discovery that if the grid of a vacuum tube amplifier is made to operate by potential and not by current the distortion produced in the input circuit by current (and reproduced in amplified form in the output circuit) could be prevented, and that this restriction to potential operation could be attained by the application to the grid of a suitable initial negative potential on which the signals to be amplified are superposed." A. Yes.

360 The Court: What page is that?

Mr. Ashton: Page 3 of the printed copy, second paragraph under the heading "Lowenstein patent."

A. (Continuing.) What Lowenstein accomplishes by the application of the negative grid bias is just what is referred to in this last quotation, beginning at line 50, page 1 of the patent. He converts the audion into a device which operates purely by voltage without drawing any current. I have pointed out that the heating of the filament 16 produces a sort of cloud of electrons around the filament. In order that they

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may be drawn across to the plate, it is necessary that the so-called B battery be provided, which gives a positive potential to the plate 17; thereupon the electrons flow across like a swarm of bees passing from the filament to the plate. That constitutes a current, perhaps the same electrons continue on through the circuit flowing in the reverse direction to the nominal flow direction of the current. But that is not known. At any rate, the electrons carrying the electricity 362
across constitute the only flow taking place in the tube.

If instead of making the plate 17 positive, it were made negative, the effect would be to tend to drive the electrons back into the filament and no current would flow across the space. When, therefore, Lowenstein made the grid, interposed between the two elements, filament and plate, negative by connecting to the so-called C battery, the negative end of the so-called C battery, he interposed a force tending to drive the electrons back into the filament, and he effectually pre- 363
vented any electrons from attaching themselves to the grid and constituting a current flowing in the input circuit. Therefore, the application of this negative bias converted the audion from a device taking current in its grid circuit to one whose grid circuit was rendered impervious to current. Therefore, he converted it into a potential operated device in the strict sense, that its grid circuit will not draw current from the line unless the signal voltage brought in by the line exceeds the negative bias imposed by the battery C. What that means, your Honor, looking at Exhibit 6, for example, is, if we take the idea

of these irregular peaks constituting sound waves, the height above the mean or zero line which would lie through the middle of the curve, as representing the voltage brought in by the line, so long as the voltage of the battery C exceeds these instantaneous high peaks, then the grid will continually remain negative and current will not flow in the grid circuit. The device becomes a purely potentially operated device.

365 Referring to the specification at page 1, line 106, after describing circuit arrangements, Lowenstein says, "The potential created in secondary 13 (due, of course, to the current coming in on the line) are made to control the current flowing through the ionic field and originating in battery 21"—I think I have explained that the electrons passing from the filament to the plate, each being a negative charge of electricity, sets up a field of its own, at the same time that it is traveling on the electrostatic field other than by the plate. The expression "ionic field" mere-

366 ly means a space in which ions are traveling and the term "ion" is a broad term for any particle carrying an electric charge. It may be merely an electron; it may be an electron attached to an atom; it may be an atom that has lost an electron, and, therefore, carries the positive charge. The term has this broad meaning. As referring to the successful operation of the audion, it means what we call electrons or negative charges.

He speaks of the current as originating in a battery. Of course, it does. The energy supplied comes from the battery and the battery is regarded as a source of current, notwithstanding

the fact that the electrons that carry it in the space have been boiled out of the filament. Continuing, the quote says: "originating in battery 21 by connecting the one terminal of coil 13 to the modulating member 18." That is the grid. He continues: "and the other terminal of said coil to a point on the battery 21, which is located ultra-negatively relative to the negative point of the battery connected to the filament."

The battery connected to the filament (bat- 368
tery 19) is connected to a battery 21 as indicated by the arrow, and what this statement means is that while one end of the coil 13 is connected to the grid, the other end is connected to a point on the battery, ultra-negative with respect to the terminal of the battery of the filament. In other words, another way of saying that would be that the filament has its negative end connected to the battery 21 at a point positive with relation to the connection of the return end of the grid circuit. The positive end of the battery 21 is indicated at the left by an arrow 369
in the patent drawing. Each cell of the battery has a positive terminal and a negative terminal. By moving the filament connection along on this battery, any number of cells can be included in the plate circuit. Similarly any number of cells can be included in the grid circuit. As the specification points out, these adjustments are necessary to bring about the correct relations.

Continuing the reference to the specification, at page 2, line 3, it says:

> "This ultranegative connection is especially desirable and constitutes an impor-

tant feature of my invention in its preferred embodiment. The volume and clearness of speech as heard in the receiver in the arrangement shown is materially greater than where the grid 18 and coil 13 are connected, for example, to a point at the same potential as the filament 16."

371 The contrast being with a connection in which the wires returning the grid circuit to the filament were connected to the same point; or, in other words, on this diagram the wires G and F were connected together. At line 18, he says:

"Both the positive and the ultranegative points of connection to battery 21 are adjustable to enable variation of the driving potential of battery 21 for the ionic field and of the ultranegative potential."

372 Actually what the drawing shows is that the C battery is adjusted by varying the wire that leads to the positive end and the plate battery is similarly adjusted by the wire that leads to its positive end. In this way operation in response to incoming signals is effected without drawing current from the telephone line, and in response only to the potential variations.

Mr. Ashton: I offer the diagram, which is a copy of a portion of the Lowenstein drawing with the addition of red lettering to indicate the various elements, as Plaintiffs' Exhibit No. 20.

(Marked Plaintiffs' Exhibit No. 20.)

The Witness: The insertion of the battery C, as shown on Exhibit No. 20, requires a readjust-

ment of the battery B if the same current is to flow in the plate circuit as flowed before the insertion of the battery C. In other words, the grid bias makes it more difficult for the electrons to get across. The higher positive voltage on the plate 17 is required to bring that about. This seeming disadvantage is in fact a very great advantage, because it has the effect of shifting more of the actual available useful range of the audion into the region where negative operation 374
or operation of the grid negatively is possible.

It therefore not only increases the faithfulness of repetition due to the line, but also to some extent the faithfulness of the repetition due to the tube. It increases the tube's capacity to operate effectively—that is a better way to put it—permitting the use of higher plate voltages.

If we take as zero the point where the arrow attached to the line F is connected—that is, taking that as the negative terminal of the battery B—then the farther the arrow P is moved to the right, the higher the positive potential with ref- 375
erence to that base or zero point for the filament. Now, as we go the other way, the farther we go the more negative would the wire G become.

The specification points out that the resulting operation of the audion is an operation which so far as the input of the tube is concerned is substantially energyless; no energy is drawn.

Q. What line are you referring to? A. I am referring particularly to page 2, lines 68 to 90. He says:

> 'By providing a modifying or controlling device, such for example as the modu-

lating means 18, which is subjected to an impressed potential more negative than that of the cathode and which is adapted and arranged to interpose between the anode and cathode modifying or controlling field of the desired character, the potential gradient between the filament and the controlling device or modulating means may be changed and thereby the current
377 which flows through the ionic circuit changed accordingly.''

Is that expression 'potential gradient'' clear to your Honor?

The Court: No, it is not.

The Witness: We can illustrate it by using the analogy of a geographical gradient. We might say, for example, that at the top of a hill we have a certain gravital potential; at the bottom
378 we are a little nearer the centre of the earth and we have another gravital potential. This slope from the top of the hill to the bottom would represent the potential gradient. That concept is used as applying to electrostatic fields. The plate 17 is positive. In the ordinary sense of our terminology, it is, therefore, at a higher potential than the filament 16. That potential decreases all along the space. If we had merely the battery B, the filament not heated, the grid absent, we would have a substantially uniform potential gradient all the way down.

Now, as soon as the filament begins to emit electrons, a negative area is created around the

filament and the gradient is no longer regulated. It comes down more steeply. The gradient from the plate to the bend may be regarded as uniform to the outer edge of this halo of electrons. When we put the grid in and give it a negative bias, then we put a hollow in the middle of our gradient, so to speak, and the gradient now runs from the plate to the grid, which is even at a lower potential than the filament.

So that we have a very irregular potential gradient between the two, and that irregularity is capable of rapid adjustment by the incoming signal applying its potential to the grid. That is the concept that the patentee is using.

He continues:

> "By applying variable potentials to the modulating means 18 the currents in the ionic field circuit are varied accordingly and as the impressing of a potential on conductor 18 need not be accompanied by an appreciable expenditure of energy, whereas the energy of the ionic field circuit is varying considerably, I have a means to produce great changes of energy in that field circuit by variation of potentials which do not require appreciable energy."

In other words, from the energy standpoint he is getting enormous amplification. He is taking no appreciable energy; he is getting out a large amount of energy, the value of which is determined by the battery and the number of electrons emitted, et cetera. That particular question we are coming to in a later patent.

382 *Frank N. Waterman—For Plaintiffs—Recalled—Direct.*

Q. Is this matter of the poling of the A battery dealt with by the Court of Appeals in the opinion at page 5, running over on page 6 (handing witness book)? A. Yes.

Q. Will you point out briefly what is said by the Court of Appeals there? A. The Court points out that in the case before it a controversy arose over the meaning of the passage beginning at line 106 of page 1 and extending to line 3 of
383 page 2. It was contended in that case that the expression "located ultranegatively to the negative point of the battery connected to the filament" did not mean ultranegatively with respect to the battery 19, but meant negatively with respect to the arrow indicated on Exhibit No. 20 by the letter F. Therefore, it was argued that the terminal of the battery 19 connected to F might be the positive terminal.

If that were the case, then connecting the wire G of Exhibit No. 20 to the negative end of battery 21 would not make the grid negative, unless
384 it happened that the battery C had more cells in it than the battery A, and that in the event that it did have more cells than the battery A the grid was not necessarily negative to every part of the filament.

Q. Will you explain that difference in potential from one end of the filament to the other? A. The potential difference between the terminals of a battery is exactly matched by the fall of potential in the external circuit. If the battery A has, we will say, a potential of 6 volts, then the point where it is connected to the resistance 20 will also have with reference to the negative end a potential very nearly 6 volts, because it

takes very little voltage to force a current through that simple wire. But when it comes to resistance 20, that as its name indicates requires some considerable drop of pressure. 385

By the time, therefore, that we got to the left hand end of resistance 20 the potential at the other end of the battery might be only 5 volts. The useful work of the current is being accomplished in heating the filament. The filament would not be heated except that it has resistance. 386
Therefore, the 5 volts which I have assumed exists at the beginning of the filament 16 would be all consumed by the time that the current gets back to the negative end of the battery.

If, therefore, there is a drop of five volts in the filament 16, and if the negative bias were, say, 7 volts, then the grid would only be negative with respect to so much of the filament as consumed 2 volts. It was the contention that the statement was indefinite and that "ultranegative" did not mean more negative than the most negative part of the filament, but only more 387
negative than some part of the filament.

The Court of Appeals discusses that contention, and in view of statements made in the prosecution of the case finds confirmation for its interpretation of the specification the other way—that is, as meaning that the connection is located ultranegatively with respect to the negative end of the battery 19 connected to the filament.

Q. Will you point out the location of the Lowenstein invention in defendant's circuits, and explain how that negative potential is applied to the grid? A. Referring to Plaintiffs' Ex-

hibit No. 2, the grid of the vacuum tube V-1 in the amplifier A-41 is connected through the resistance L to the bottom end or lower end of the resistance R-1. The current which heats the filament of the tube V-1 comes from the battery A and flows through a regulating resistance corresponding to the resistance 20 of the Lowenstein patent, thence through the filament, thence back through the resistance R-1 to the negative
389 terminal of the battery.

What happens, therefore, is that a part of the battery voltage is consumed in the first resistance, and another part is consumed in the filament, and the remainder is consumed in the resistance R-1. The point to which the grid is connected, namely, the lower end of the resistance R-1, has substantially the voltage of the negative end of the battery. The top end of that resistance which is connected to the filament has a considerably higher voltage, because of the loss of voltage occurring in the resistance R-1.
390 Therefore the filament in the tube V-1, looking across at the grid, sees the grid negatively biased with respect to itself by the amount of voltage that is required to force the current from the filament back to the battery.

I may state that this drawing is made in accordance with a conventional illustration of the audion that is not infrequently used where for the sake of orderly succession of connections through the circuit the grid is shown at the left side of the cathode while the plate is shown at the other side. But that does not indicate any structural difference. It is actually placed be-

tween the plate and the filament in the mechanical structure.

The resistance R-1, therefore, constitutes the means by which the tube V-1 is negatively biased. Exactly the same sort of bias arrangement is provided for the tube V-2, the resistance R-2 being in this case that which provides the bias, and the grid of the tube V-1 is connected through the lower portion of D-1 to the lower end of the resistance R-2. 392

The vacuum tube V-3 of intermediate amplifier A-36 is biased in a little different way. In this instance the tube V-3 has what is known as an indirectly heated cathode. It is a tube known to the trade by the number 227. Its filament is not the direct source of the electrons. The filament is what is known as a heater which heats an envelope surrounding itself, indicated by the little hooked line in this diagram. It is otherwise known as a unipotential cathode tube, because there is no difference of potential anywhere along it. The difference of potential which I ex- 393 plained occurs in the filament of a tube is sometimes a disadvantage. Particularly is that the case when there is the possibility that the heating current may itself vary some, and where the heating current is derived from an alternating current circuit it becomes a matter of very great advantage to not have the heating current flow in the cathode itself at all. Therefore, the unipotential cathode heated merely by radiation from a little heater contained inside of itself is employed.

The plate current flowing through the tube V-3 can be traced from the Power Pack P-32, the

connection just at the left of the letter E. It flows up through the coil G-1, the coil G-2, to the plate; thence across to the unipotential cathode, thence down through the resistance R-3, thence to the right and down to the negative end of the resistance—that is to say, the left hand end of the resistance indicated by the letter E.

In an exactly similar manner the entire plate
395 voltage which is provided by the Power Pack P-32 is expended in this external circuit. If the voltage, for example, is 100 volts, some little portion of that is expended in G-1 and some small portion in G-2, most of it is expended in the space between the plate and the cathode of the tube V-3, what is left is expended in the resistance R-3. It reaches the negative or for this purpose zero terminal of the supply. The grid of the tube V-3 is connected through the transformer secondary S-3 and through another resistance to the lower end of the resistance R-3.
396 It therefore is more negative than the cathode by the amount of voltage required to force the plate current through the resistance R-3.

The tubes V-4 and V-5 of the intermediate amplifier A-36 are biased in a precisely similar manner, although the method of illustration is necessarily a little different. These two tubes V-4 and V-5 are tubes of the filament type and are operated in parallel from a circuit derived from the Power Pack P-32. That is to say, the two conductors come up and connect to the filaments in such manner that the current divides going through the filaments of the two tubes, unites again and returns to the supply. Across

these two conductors there is connected a T-shaped resistance arrangement R-4. This resistance consists of a branch connected across the two wires which continually carries a certain amount of current corresponding to the filament current. The centre point of that resistance represents the mean potential point of the entire cathode. That means this: starting from one end of the filament the current flows through to the other end. If the drop of potential through 398
the filament is, say, 6 volts, there will be 3 volts of that lost to one end of the filament and the other 3 volts lost to the other end of the filament.

If we now put a resistance across the conductor carrying that current, there will be equally 6 volts lost across that resistance. By tapping a suitable point at the middle we can find a point which has the same potential as the middle of the filament. The reason that expedient was adopted is that the filaments of those tubes are heated not by direct current but by alternating current. The noise that that alternating current would set up in the filament would be terrific if the connection were made to one end of the filament. It is therefore necessary to get a point in the filament whose potential does not vary. That is the mean point, because whichever way the current is going through the filament the mean potential point remains the same.

Therefore, the actual biasing resistance of this group of resistances R-4 is connected to that mean potential point, and the plate current going in this instance from the right hand terminal of the resistance E, passes through G-3 to the

middle point of the transformer secondary P-5. There it divides, one half of it flowing to the plate of V-4 and the other half to the plate of V-5. It then flows through the tubes to the filament, out the two sides of the filament, through the resistance to the middle point which is at the top end of the lower branch of the resistance R-4. Thence it flows through R-4 and back to the left hand end of the resistance E in the
401 power pack P-32. Here again it is the voltage loss in the resistance R-4 which is impressed upon the grid. The plate current flowing across to the filament after passing through the resistance R-4 leaves the filament at a higher voltage than the lower end of the resistance R-4.

The grids of the tubes V-4, V-5 have the same potential as the lower end of the resistance R-4, because no current is flowing through them, therefore no voltage is consumed. So the grids of those two tubes are given the ultranegative bias.

402 Q. Is the same also true of the PA-39 amplifier by means of the resistance R-5? A. Yes, and it is accomplished in exactly the same manner, although in this instance it is the center of the transformer which is tapped. That is, the transformer is so tapped as to take out a potential equal to the mean potential of the filaments; because in this instance no resistances are interposed in the least. This means that when this PA-39 amplifier is wired up equal lengths of conductors are taken from its two terminals to the two filament terminals. They therefore have the same potential essentially as the terminals of the transformer. In order

to get the potential which is the mean potential of the filaments, it is only necessary to find that point in the transformer, and that is what is done. Then the resistance R-5 is connected in a lead going to the plate circuit.

The current in this instance for the plate circuit comes from the top end of the filter F-2 of the power supply apparatus associated with the amplifier PA-39. It flows to the midpoint of the transformer primary P-6, divides, flowing to the 404
two plates of the tubes V-6, V-7, through the space to the filaments down the two leads to the secondary S-11, to the middle point, up through the resistance R-5 to the right and over to the negative end of the filter F-2, which is at the left.

The grids of the tubes V-6, V-7 are connected to the low potential side of the resistance R-5, namely its top end, by a center tap in the secondary S-5 of the input transformer. The grids, therefore, have the potential of the negative end of the supply, while the filaments of the 405
tubes have a potential as much higher as the loss of voltage in the resistance R-5.

Q. Will you now take up the Mathes patent, and particularly Claim 8—Claim 6 being relied upon as to the A-41 amplifier only? A. The Mathes patent discloses a simple method of producing the bias for the grid without the addition of a special battery for the purpose. In Fig. 1 two batteries 6 and 5 are shown; or, otherwise looked at, the single battery with two sections 5 and 6. The tube 1 has its plate 4 supplied from the positive end of the section 5, while the filament is supplied with current from the

section 6, and flows from the positive or right hand end of the battery 6 up through the filament 3, thence to the left through the resistance 9, thence down through the regulating resistance 15, thence through the choke coil 14 back to the negative end of the battery. The total potential of the battery 6 is expended in this external circuit, part of it being lost in the filament 3 and part in the resistance 9, and the
407 balance in the devices 14, 15.

The result is that the left hand end of the resistance 9 is at a lower potential than the right hand end, and therefore at a lower potential than any part of the filament 3. The grid 2 connects through the lower half of the resistance 10 to the left hand end of the resistance 9. The grid, therefore, has impressed on it the potential of the left hand end of the resistance 9.

This drawing shows the batteries 5, 6 as provided with charging means. The arrangement contemplated is that the amplifier is operated,
408 for example, at a relay station where there is a large battery used for other purposes. This battery is tapped off suitably for the purposes of the amplifier, but since the battery is a general purpose battery it is charged in regular routine, for example, perhaps once a day. When the switch, which is not lettered but is just to the right of the numeral 19, or about an inch to the right of numeral 19 in the drawing, is closed and the generator indicated by the numeral 19 is in operation, then the battery is being charged and current flows in to the right hand terminal of the battery 5, thence through the battery 6 and back to the other terminal of

the generator. This has the effect of raising the voltage of the battery. At the same time it would raise the current through the filament. But also at the same time it would increase the bias on the grid, because more current would be flowing through the resistance 9. There is, therefore, a compensating effect due to the increased drop in the resistance 9 to offset the rise in voltage of the battery 5 and increased current in the filament 3.

410

In other words, when the voltage of the batteries 5 and 6 rises and therefore the plate current in the tube tends to rise due to the increased plate voltage and the increased filament temperature, the bias due to the resistance 9 increases, the grid becomes more negative, which tends to restore the condition. In other words, as the patentee points out, there is a partial compensation to fluctuation in voltage in the battery. I might add that this is also true for momentary fluctuations as well as for large well maintained changes that occur in charging. 411 The generator 19 is likely to produce some pulsations. The purpose of the choke coil 14 is to exclude those pulsations from its circuit, the choke coil acting to develop a high impedance to variable current, although having almost no resistance to a constant current. Would you like to have that explanation, or will your Honor just take it as it is stated?

The Court: I do not believe that will be questioned, will it?

Mr. Ashton: No, your Honor, I do not think it is necessary.

The Witness: It may be necessary to explain it in connection with some other later patent.

Mr. Darby: May I say for your Honor's guidance that we are not questioning anything in connection with the description of the patents. So that anything Mr. Waterman says about them will be accepted. That might possibly expedite it
413 a little bit.

The Witness: That is, in substance, the disclosure of the Mathes patent insofar as the description of Claim 8 goes.

Q. Do I understand you to say the advantages which you have referred to, particularly this compensating advantage, is an advantage over the invention of the Lowenstein patent? A. It provides an advantage over the Lowenstein patent where the voltage supplies may be variable. It attains in other respects the same result as
414 the Lowenstein patent in a simpler way.

Q. It eliminates the necessity of having the third or C battery? A. Yes.

Q. And that is referred to in the Bunnell opinion on page 7, where the Court states, "The A battery is used for biasing the grid, thereby eliminating the C battery?" A. That is correct. I might point out that the specification of the Mathes patent beginning at page 1, line 27, states that such fluctuations are troublesome. I have not thought it necessary to go into the explanation of the various effects produced, but it points out that such variations are troublesome and the partial compensation resulting in a measure removed that.

The patentee goes on and in another figure shows and in the specification describes means of making the compensation more exact. For example, at the bottom of page 1, line 109, he says that: "By the variation of the character of resistance 9, more exact compensation can be obtained."

He then goes on to suggest that the resistance might be one which varied its own resistance with the flow of current through it. There are re- 416
sistances, for instance, which can be made to increase very rapidly when a little more than a normal current flows through them, and that would produce a compensating effect in one way. In Fig. 3, he shows a tube device 15 which will decrease its resistance when current flows through it. Those are not involved in the defendant's apparatus and I had not thought it necessary to dwell upon them.

Q. Did you refer to page 1, lines 27 to 32? A. Yes, I did.

Q. Now, as I understand your previous testi- 417
mony with regard to the resistances R-1, R-2, R-3, R-4 and R-5 in defendant's circuit, these are the resistances in the grid filament circuit in each of these stages of the defendant's amplifier, is that correct? A. The resistances R-3, R-4 and R-5 are in the plate filament circuit and also in the grid filament circuit. The resistances R-1 and R-2 are in the filament circuit.

Q. That is in the A-41 amplifier? A. That is in the A-41 amplifier.

Q. Those are the resistances which are covered by claim 8 of the Mathes patent? A. As a matter of technical description, claim 8 reads on the

amplifier A-41, having in mind the resistances R-1 and R-2 which are contained in the filament circuit and also in the grid circuit.

Q. Now, will you take up the Arnold Patent No. 1,329,283, the power circuit patent of which claims 7, 10 and 13 are relied upon, as to the power amplifier PA-39, in defendant's circuit? A. This Arnold patent No. 1,329,283 goes to the constitution of an efficient power circuit arrange-
419 ment whereby the final stage in the amplifier, or for that matter, any other stage if you choose to use it, may be made to efficiently deliver power to the end of obtaining maximum power.

The specification starts with a rather extended series of definitions and discussions of the device, that I think perhaps it will be necessary to explain. I believe that all of the terms used in the first two or three paragraphs have been defined. I shall refer to line 15, however, where it says: "This object (namely the production of audions with any desired characteristics) is ac-
420 complished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in this specification."

It will perhaps be necessary to use that expression "geometrical" or "the geometry of the tube" merely as referring to its special relation to the size of its element and the mode of construction of the grid and the like. Those are all comprehended broadly under the term "geometrical."

Beginning at line 28, it is said: "The thermionic amplifier consists of a hot electron-emitting cathode, such as the so-called 'Wehnelt' cathode,

of a cool anode and of an auxiliary electrode called the grid, which is usually, though not always, located between the anode and the cathode."

The Wehnelt cathode is a strip of wire or conducting material,—platinum used to be used, although baser metals are used nowadays to a considerable extent, and coated with the oxides of some of the rarer metals, such as barium and strontium and the like, which have apparently a 422
particularly loose hold on their electrons. They emit electrons very freely and at quite low temperatures. That accounts for the fact that some of the tubes, such as perhaps your Honor has noticed, do not give a very bright glow, and such tubes have what is known as the Wehnelt cathode, in which the electrons are emitted from a coating of barium or strontium or a similar metal in the form of oxid placed upon the actual filament conductor.

The patent then points out that the plate battery is employed to force the electrons across the 423
anode, thus setting up a convection current (line 36), the convection current carried by electrons in the evacuated space. The word "convection" is used in physics to mean the transfer by particles, one at a time, as for instance, we speak of the heat by convection, for example, the heating up of the air adjacent to a radiator, which moves on and its place is taken by another particle; in the tube, we have electrons carrying one charge, and another carrying another charge, and the "swarm of bees" figure is sometimes used to picture the convection current that the patentee refers to.

Skipping to line 44, the following statement is made: "Due to the presence of those electrons, a negative space charge is established between the anode and the cathode, whose effect is to limit the number of electrons which can leave the cathode, and consequently to limit also the current which can flow in the output circuit, by which is meant the circuit including the battery and the path of the space current."

425 I think I have already defined all the ideas that are involved in that. Each electron being a charge, contributes its portion to building up a space charge. Each electron in its motion across from the filament to the plate is reacting back on other electrons, tending to prevent their coming out. When enough of them are en route between the filament and the plate, no more will come out.

By the Court:

Q. A case of overproduction? A. Overproduc-

426 tion. This is the condition of affairs when no signal is coming in. With calls, the plate signal, —the current in the plate circuit rises to a certain value and stops. It stops because of this action of the space charge. He goes on: "The object of the grid is to furnish a means for introducing a further negative charge into the space between the anode and the cathode, or for introducing into it a positive charge which shall neutralize the effect of part of the space charge due to the electrons."

All of this latter portion, beginning there at line 44, reciting the object, Arnold, as far as I know for the first time introduced this, and this

was a new doctrine. The operation of the tube had been a complete mystery. This elucidation was brought about by the work of Dr. Arnold. The conception of the space charge was quite a novel one. It has become standard terminology in the art, but it was wholly new, as Arnold initiated it, as I understand it. At least I am not familiar with its being found elsewhere. So Arnold points out that the grid serves as a means of introducing a further negative charge 428
or for introducing a positive charge into the space. That I have already explained in connection with the discussion of the simple audion diagram. Arnold goes on (line 59): "In the first case, the convection current is decreased; in the second it is increased. In order to force this charge to the grid, a source of electromotive force is connected between grid and cathode, that is, between the input terminals of the device. The effect of such an impressed electromotive force is therefore to alter the magnitude of the space current in the amplifier by changing the 429
distribution of space charge between the electrodes, and morever this is accomplished without requiring that the impressed electromotive force shall do more work than that involved in forcing the charge to the grid against the counter voltage of the condenser formed by grid and filament."

I have already pointed out that any two conductors that are insulated from one another, are regarded as a condenser. To establish a difference of potential in the conductor, a very minute amount of electricity must be forced into it, and it stays there, and that is, in the case of so small

a condenser, almost an infinitesimal quantity. Nevertheless, Arnold takes that into consideration as something necessary to establish the potential. He says that no more energy than that trivial amount is required in the grid.

This discussion goes to the concept of what is known as an alternating current resistance of the plate circuit of the tube. In the middle part of column 1, at page 1, he dealt with steady cur-
431 rent. He shows how the tube will act as though it had a direct current resistance, and the current will stop increasing just as it would with a resistance, but when you come to the action of the grid to increase and decrease the current, as pointed out, beginning line 59, we have quite another effect. The resistance is not the same. In fact, it is continually changing, but there is here introduced a concept of a variable resistance of the tube, which is a wholly different resistance from this constant resistance which is known as the AC resistance.

432 To make a simple illustration, when a steady state has been established, no signal coming into the grid, we vary the plate voltage a little, there will be a resultant change in plate current. If we deduce from those two things what the resistance of the tube is, we will find it is entirely different from that which we deduce if we take the whole voltage and the whole current. That is alternating current resistance.

By Mr. Ashton:

Q. That is, you have two resistances that you have to think about, the DC resistance and the AC resistance? A. Yes, sir.

Q. The tube ordinarily conducts current in one direction and that is a resistance which you can speak of as a DC resistance? A. That is correct. When it is carrying the one current which is superposed on the direct current to constitute the signal, then it is quite another resistance.

By the Court:

Q. Perhaps it is not important, but I do not 434
just understand what is the source of the alternating current in this A-41. A. The alternating current comes from the film of light and dark areas on the film. The light shines through and produces an emission of electrons from the sensitive surface of the photo-electric cell which flow through the plate circuit including the resistance K. They develop a variation in the potential difference between the top end of the resistance K and the battery which is supplying the small, feeble current. These variations constitute, in effect, alternating current, superposed 435
on the battery. It is only in the photo-electric cell, just as in the enlarged form, they constitute an alternating current superposed on the direct current furnished by the battery B-1 and the plate circuit on the tube B-1.

Mr. Ashton: The light shining on the film through the cell, the light actually causing this change of current in the photo-electric cell. As Mr. Waterman explains, when the light hits this potassium or other metal in the cell, electrons are given off and they flow in that circuit, and

if the light is a little more or a little less, it makes the variations in the circuit correspondingly.

The Witness: The current there in that event is just as in the tube, carried across by the electrons from the surface from which they are emitted to the element which is represented in Exhibit 2 by the circle drawn inside; it is just a little rod
437 inside of the photo-electric cell.

By Mr. Ashton:

Q. I believe you stated that this idea of the tube having resistance or impedance was not known before? A. As far as I know, it was a discovery of Arnold's that the tube possessed this property of definite alternating current resistance.

The specification then proceeds to define further terms, continuing at line 75, it says: "Since in this operation the change in power consumed
438 in the output circuit may be much greater than that required in charging the condenser, the device acts as an amplifier."

I have already pointed that out in considering the Lowenstein patent.

"This variation in space current, due to an impressed electromotive force, will hereafter be called the output current of the amplifier."

I call your Honor's attention to the specific language; it is this variation in space current which constitutes the alternating current. In other words, an alternating current is superposed upon the direct current, and that alternating current is called output current.

The patentee then goes on to differentiate precisely what he means. He means the alternating current as distinguished from the direct current would flow whether there was any signal coming in or not. He says at line 86: "The reason for adopting these definitions is that in the practical application of the amplifier it is only these variations in current or voltage which are utilized."

Then he makes a statement which is very excellent proof of the concept that regards the alternating current as superposed on the direct. He says at line 90: "In fact, a transformer is ordinarily used to derive power from the output circuit, and obviously the steady space current or the steady output voltage have no effect in the secondary of that transformer and may be ignored for practical purposes." 440

It is a perfectly well known fact that if you send direct current through a transformer, you get no effect in the secondary, but when you send the current that comes out of the tube to the transformer, you do, you get variable frequency current in the tube, which corresponds to the socket, showing that it is really an alternating current superposed on the direct current. Then he proceeds to define the term, "voltage amplification." He says: "The term voltage amplification means here the ratio of the alternating voltage appearing in the secondary of such a unity ratio transformer to the alternating volt age impressed upon the filament and grid"—"unity ratio" means primary turns and secondary turns; that is, if you put one volt of alternating current in one end, you get one volt out 441

of the other. He defines the voltage amplification in terms of the ratio of the voltage you get out of such a transformer and the voltage that you put in at the grid.

Q. Will you continue with the Arnold Power Circuit patent? A. At line 96 he says:

> "Thus, the term voltage amplification means here the ratio of the alternating
443 voltage appearing in the secondary of such a unity ratio transformer to the alternating voltage impressed across the filament and grid, when the transformer primary is made to include the whole of the output circuit external to the amplifier. In simpler terms, it is the ratio of the above defined output voltage to the impressed input voltage."

It may be necessary to explain that the output voltage which is actually realized will depend
444 upon the load that is in the output circuit, and is never the full voltage indicated by the amplification factor of the tube. Thus if the amplification factor is 8, for example, we may realize in the output circuit any part of 8 times the input voltage, depending upon the circuit.

The specification then proceeds to another definition of a quantity which is very much used in dealing with these tubes. Beginning at line 106, he says:

> "There will also be occasion to consider the ratio of output current to input voltage, the latter being taken as standard

throughout. When this ratio is high, other things being the same, the amplifier will be said to be of the high current type, and vice versa. This latter ratio is, of course, not a pure member, but is of the nature of an admittance."

That is to say, it is not the ratio of two like things, therefore it is not a pure number. It is the ratio of an output current to an input voltage. Therefore it is, as he says, "of the nature of an admittance." 446

Arithmetically speaking an admittance is the reciprocal of an impedance; a conductance is the reciprocal of a resistance. So far as we are concerned the terms "admittance" and "conductance" mean the same thing, and the art uses that term "conductance" rather than the term "admittance." But this admittance which Arnold speaks of is a characteristic and a very important characteristic of the tube, and it is known generally in the art as the mutual conductance. 447

Q. The use of that term "mutual conductance" became prevalent after this time, did it? A. Oh, long after, yes. But it has come to be an important factor in the rating of a tube; and, as Arnold states, when that number is large then the tube becomes what the art knows as a power tube, a power type. Arnold says "high current type," which for our purposes is the same thing. He then goes on to point out that it has been found that amplifiers may be designed for given circuit conditions, so that they will have whichever of the abovementioned characteristics is de-

sired. That is, they may have voltage amplification that we have been considering, or they may have the high mutual admittance or mutual conductance—namely, have a high current output.

He goes on at line 9:

> "That is, one may be designed to deliver to a receiving device a comparatively high voltage with a low current, or vice
> 449 versa. The principles of operation which have been discovered which enables this result to be accomplished may be stated as follows."

Then he proceeds to take up the design characteristics of the tubes by which their performance is controlled. He points out that it is desirable in all cases to have the grid close to the filament, that the voltage amplifying characteristic may be given by a relatively wide spacing as shown in Fig. 1 and the high current by a relatively close spacing, as shown in Fig. 2, par-
450 ticularly of the plate with regard to the filament.

Then at line 51 he says:

> "A third principle of operation of the thermionic repeater which has been discovered may be stated as follows. To increase voltage amplification decrease the ratio of open space in the grid to conducting surface, and to decrease voltage amplification or to increase the variable output current increase this ratio."

In other words, this filament looking at the grid sees the path between it and the plate largely obstructed by the grid. Then the amplification

factor of the tube will be high, whereas if the space is widely opened then the amplification factor will be lower but the current that the tube will give, other things being the same, will be greater.

Q. Is this illustrated by comparison of the tubes previously put in evidence, Plaintiffs' Exhibit 12 which is the M-type tube, and Plaintiffs' Exhibit 16, which is the D-type tube and Plaintiffs' Exhibit 18, which is the W-type tube (handing witness)? A. Yes. Exhibit 16 or D-type tube has a comparatively small plate area and a very closely wound grid. In both cases the grid is about as close to the filament as it is safe to put it. The grid is composed of many wires quite close together so that the filament looking through to the plate sees a large obstruction to its passage. 452

Mr. Ashton: Can your Honor see the filament in that tube? It is the wires that come down.

The Court: I would say it is a separation of about a sixteenth of an inch or less from the grid. 453

The Witness: Yes, it is a little crinkled wire stretched in V-shape in the very center between the elements.

Q. The apex at the top? A. The apex at the top. Exhibit 12 of the M type tube is different. It has a larger plate area; its grid is composed of very few wires, widely spaced. The filament is, as before, an inverted V, mounted centrally of the structure. In each of the tubes the grid covers both sides of the filament. There are two grids parallel to the plane of the filament and

two plates parallel to the plane of the filament and the grids.

This spacing in the tube of the grid and several of the elements are about the same as in the tube, but the plate is larger in the M type tube. An increase of plate area is equivalent to a closing up of the spacing. In so far as affecting the characteristics of the tube are concerned, the high current type tube having to carry a
455 much higher current, gets hotter in its operation. I have not yet given any reason why it should get hotter, perhaps therefore I ought to point out why it is. Perhaps the easiest way of comprehending the presence of the resistance in the tube is to realize that the plate battery has to accelerate those electrons; the coming off of the electrons from the filament constitute a haze of the filament; they have to be speeded off and across the plate. The energy which each electron carries, therefore, is the same as that carried by any moving body. When the electrons
456 reach the plate, they are traveling at very high speed and that energy or momentum they carry is given off in the form of heat on the plate, with the result that the plate gets quite hot. In the power tubes used in our radio sets, it is not uncommon, if one watches closely, to see that the plates are red hot. That is the result of the bombardment by this swarm of electrons moving from the filament to the plate. That heat has to be gotten rid of, therefore, the plate has to be made of a size that will radiate the heat. Increasing the size, reduces the resistance of the tube. Therefore the M type tube Exhibit 12, is a tube with a lower amplification factor and

higher current output than is the case with the D type tube 15. The specification continues, line 59, page 2: "The behavior of thermionic repeaters in another very important respect has been discovered. This may be stated as a fourth principle of operation as follows: Maximum efficiency is obtained when the impedance between the anode and cathode is equal to the total impedance of the variable current consumption circuit. This total impedance includes the 458
total line impedance and that of the receiving or translating device or devices to which power is being supplied.

"It has been found that tubes may be constructed in such manner as to take advantage of any number or all of the above mentioned principles with, of course, correspondingly increased efficiency and adaptability.

"An object of this invention is to provide an audion, or an equivalent device, which will amplify the variable energy supplied thereto without at the same time causing a large voltage 459
amplification."

That is illustrated by the M type of tube. It does not cause anything like so much, or so large amplification of voltage as in the case of the D type, but it gives larger output of current. Your Honor will recall that the power output is determined by the product of the voltage and the current. Continuing he says: "To provide an audion, or equivalent device, which will cause the amplified energy which appears in the output circuit to take the form of large variable current, rather than smaller variable current with large voltage amplification."

460 The W type tube is a large form of the power tube in which the area of the plate required to radiate the heat is very large indeed. The grid will be seen to consist of wires very widely spaced. They are about an inch apart. Your Honor can see the grid structure.

By the Court:

461 Q. The outside metal part is the plate? A. The outside metal part is the plate. There are two plates, one on each side of the central filament, then the grid itself which has wires very coarsely spaced—about an inch apart.

By Mr. Ashton:

Q. It goes all the way down? A. Yes. The elements of the tube are crowded as close together as the necessary electrical separation permits, and the tube has very low impedance and
462 capable of giving very large output of current with comparatively small voltage amplification.

By the Court:

Q. These are the plates, that look like shutters? A. Yes, your Honor. The plate is formed by bending strips of material back and forth, that being merely a provision to assist in the evacuation. It is a very difficult matter to get all the gas that is either absorbed or occluded out of the elements, and it is quite common to make the elements in such a manner that they can be treated during the process of exhaustion.

463

By making a plate in this manner, it is possible to send the current through it and heat it up and drive the gases out of it.

Mr. Ashton: I offer in evidence section model of copy of the 201-A tube which is used in the first two stages of defendant's amplifiers, that is in the A-41 amplifier, as Plaintiffs' Exhibit 21.

(Marked Plaintiffs' Exhibit No. 21.)

464

Mr. Ashton: And a similar model of the 226 tube which is used in the push-pull circuit of tubes V-4 and V-5 in amplifier A-36, as Plaintiffs' Exhibit 22.

(Marked Plaintiffs' Exhibit No. 22.)

Mr. Ashton: Also similar model of the 250 type tube which is used in defendant's power amplifier as tubes V-6 and V-7, as Plaintiffs' Exhibit 23.

(Marked Plaintiffs' Exhibit No. 23.)

By Mr. Ashton:

465

Q. Will you please point out briefly the geometry of these tubes? A. Exhibit 21, which is a unit of the 201-A tube, the exterior globe being broken away, shows the tube as consisting of a central filament of the inverted V type, having a small hook on top, surrounded by a grid of wires rather close together and that, in turn, surrounded by the plate element in the form of a sort of rectangular box with extensions on the sides for support.

The 226 tube which is Exhibit 22 is quite similar in structure, the difference between those

tubes is mostly that the filament is quite different in its construction in 226 and is of such a low voltage, that it can be used as an alternating current tube, that is, with the alternating current supply, and still have the current go through the cathode element. It is this tube which has the resistance R-4 in defendant's A-36 amplifier for getting the mean potential of the filament and providing bias. This filament, as
467 I recall, takes only about 2 volts, where the filament of 201, Plaintiffs' Exhibit 21, requires 5 volts, and the amount of disturbance introduced by the alternating current on the filament depends quite largely upon the number of volts expended in the filament to set up the electrostatic field of their own inside. Therefore the 226 tube is successfully used as an alternating current tube, that is alternating current heated, whereas the 201-A tube cannot be so used.

Q. Are the tubes of Exhibits 21 and 22 voltage amplification tubes? A. Only as compared
468 with the 250. They are more commonly known as "all apparatus tubes." They have an amplification factor of 8 or thereabouts, but not nearly so high as this D tube, for example. I do not know what the amplification factor of that tube is, but it is evidently of the order of 30 or 40.

By the Court:

Q. You are now referring to what? A. Exhibit 16.

By Mr. Ashton:

Q. Will you now refer to the 250 tube, which is Exhibit 23? A. Exhibit 23 is a power output

tube and it is characterized in the first place by very large plate area which is necessary, in order to get rid of the heat, due to the electron bombardment. It is next characterized by the grid wires being quite widely spaced. You will find the wires quite widely spaced, so that the filament, which in this instance is in the form of an M, that is, two inverted V's looking at the plate sees a comparatively open space; little interference with the electrons rises and the 470
amplification factor is quite low, of the order of 3-½, while the plate circuit resistance is also quite low. The output current is relatively large indeed. This tube has a mutual conductance, as I recall, of about 2000, whereas the No. 201 has a mutual conductance of about 700.

Q. What does mutual conductance indicate? A. High mutual conductance indicates high current type of tube, that is, high capacity,—high power capacity tube.

Q. Have you completed your references to the specification? A. I have not referred to the bal- 471
ance of the figures. The Figs. 7 to 10 show circuit arrangements. In Fig. 7 there is shown a tube V in which the grid is of fine or close mesh, and the plate widely spaced. This is discussed on page 4 of the specification, beginning at line 61 and extending over to line 123.

The patentee points out that if it is desired to get the maximum output from a tube, then the load applied to it must, in accordance with the principle stated beginning at line 59 on page 2, have an impedance and it should be of the same order as the impedance of the tube and at line 119, page 3, he says: "They should at least be

of the same order of magnitude, for example, one being 100,000 ohms and the other 25,000 ohms."

He says, "The receiving device 10 may be a second amplifying tube or similar device."

Fig. 8 which is described beginning at line 124, at page 3 shows a tube of the high current type, as indicated by the open grid and closed spacing, and at page 4, line 2, he says: "The imped-
473 ance of the amplifier between filament and plate is made the same as that of the receiving device 11, or as nearly the same as other operating conditions will permit, and at least of the same order of magnitude."

Fig. 9 also has the same type of tube and differs from Fig. 8 only in detail of the circuit, and perhaps I ought to define that feature. Your Honor will notice in looking at Figs. 7, 8 and 9, that the direct current is not carried through the receiving device itself, but comes from battery B and goes through a choke coil 8 in Figs.
474 7 and 8 and through resistance 13 in Fig. 9, while the load, the actual working device carrying alternating current is connected through a condenser. This is what is known as the parallel feed method. It is parallel feed as distinguished from Fig. 10, for example, where primary 17 of the transformer carries not only the alternating current, but the direct current, the direct current source being indicated at B^1, a generating machine, in this instance.

The specification points out that the devices 8 and 13 are made of such high impedance that little or none of the alternating current will be shunted. The direct will go through, but the

alternating current will come out through the receiving device.

Again with respect to Fig. 9, it is pointed out that the high current low voltage amplification type of amplifier is here shown. A tube impedance of the same order as of the telephone receiver 15, being thus obtained. Then it is pointed out that Fig. 10 shows the transformer type of connection and that the tube V^1 is looking into that primary and should be of the same order as 476
primary 17 looking into the tube and if this is of relatively high value, then the tube will be applied accordingly; if it is relatively of low value, the tube will be applied accordingly.

I refer, for instance, to page 4, line 57, as contrasted with page 4, line 39.

This selection of the tube and circuit to have impedance of the same order is a very important factor in determining the effective power amplification of the tube and it is therefore one that is carefully embodied particularly in power stages where the final product which is always 477
power, has to be delivered.

Mr. Ashton: I would like to call your Honor's attention to the fact that this patent contains some claims which are for the tube itself, but that the claims here relied upon are for the combination of the tube with the circuit, and not for the tube itself. In this patent, the claims that we are relying upon are 7, 10 and 13.

The Witness: The subject matter of those claims technically considered is the organization of an output circuit with this

relation of the impedances of the tube and the circuit of the same order, and it makes,—the invention makes it possible to design output circuits that will operate with large power and at the same time without distortion. It is the use of such circuits that makes possible the large volume of sound that are obtained with present-day amplifiers.

479

Q. Now, will you refer to the claims briefly in connection with the defendant's amplifier PA-39? A. Claim 7 refers to the PA-39 in which the 250 tubes are used. Their joint internal AC resistance being 3,800 ohms or 1,900 per tube. Those plate circuits look into a load, which is the two loudspeakers, which pass through the transformer, as seen by the tube, has a load of 5100 ohms, slightly larger than the impedance of the tubes, but of the same order, so that while not the absolute maximum is obtained, it is still

480 near it and very large output power is realized in the circuit. Claim 7 refers to the matching up of the circuits in this manner by construction of the tube, more particularly with respect to the anode and cathode and control element spacing.

Claim 10 recites the further feature of the mesh of the grid and is otherwise similar.

Claim 13, so far as the technical description is concerned, is rather more general and specifies that the impedance of the discharge device generally cathode and anode and of the work circuit are of the same order. The description of each

of the claims is illustrated in the PA-39 amplifier.

Q. Will you now refer to the Arnold patent 1,349,252, which is known as the Straight Line Characteristic Patent? A. What is known as the characteristic curve of a tube is obtained by measuring the output current that will flow in an instrument connected between the plate and filament when the voltage applied between the grid and the filament is progressively varied 482 from a considerable positive value progressively down to a considerable negative value.

Mr. Ashton: I offer in evidence as Plaintiffs' Exhibit 24 an illustrative characteristic curve of a vacuum tube.

(Marked Plaintiffs' Exhibit No. 24.)

A. (Continued.) If the data so acquired is plotted, the grid potentials being plotted on the horizontal axis and the current values on the vertical axis and then the points so obtained 483 are connected by a line, a curved line somewhat S-shaped is obtained which illustrates the change of plate current with changing grid voltage or potential. This is known as the characteristic curve of the tube. It is nowhere straight. But in order that the amplification which the tube is capable of delivering may be faithful, it should be straight. If it is not straight then the tube introduces into the signal frequencies that were not there originally. These frequencies are second, third, fourth and fifth harmonics chiefly, the second harmonic being the stronger, ordinarily at least.

That means that the tube can only approximate faithfulness of repetition in its own internal operation to the extent permitted by the characteristic. There will be some higher harmonics always introduced. These of course result in a distortion of the signal by the introduction into it of harmonics that are not there originally.

This patent 1,349,252 to Arnold discloses the
485 discovery that the characteristic can be straightened by the correct proportioning of the external circuit, and in brief that the characteristic will be made much straighter, approximately straight, if the resistance in the external circuit is made equal to that of the internal circuit or greater. The figures of the patent show the circuit, and in Fig. 1 it is assumed that the load indicated by the transformer not lettered is not such as would produce a straightened characteristic. Fig. 3 shows a resistance added.

In other words, the resistance does not have
486 to be in the load, and yet the load will get the straight line effect. In Fig. 5 the resistance is entirely in the load. It is shown as the load resistance across the secondary of the transformer.

Q. Labeled R1? A. Labeled R1. So making the resistance of the output circuit the load as the tube sees it equal to or greater than the internal circuit impedance of the tube straightens the characteristic. The two curves, Fig. 2 and Fig. 4, which show the straightening of the characteristic, are fractions of characteristic curve. The zero line is obviously erroneously located. Tubes never have the maximum curvature on the right side of that zero line. The zero

line should be about five-eighths of an inch over to the right in each case.

In Exhibit No. 24 your Honor will see the greatest curvature at the lower end is at the left of the zero line, and that should be the case in Figs. 2 and 4. There is obviously a draftsman's error there.

Mr. Ashton: I would like to state, your Honor, that that is the fact, that it is a draftsman's error, as the records of the Bell Laboratories show; and I will probably ask Mr. Darby to stipulate that later. 488

The Witness: The way in which this external load impedance acts to straighten the characteristic is a rather difficult thing to explain. I have a sheet containing a number of curves.

Mr. Ashton: I offer the sheet of curves referred to by the witness in evidence, as Plaintiffs' Exhibit No. 25. 489

(Marked Plaintiffs' Exhibit No. 25.)

The Witness: In describing the taking of the characteristic of Exhibit No. 24 I said nothing about the plate voltage; I merely assumed that there was a plate voltage. But the particular characteristic curve that is obtained will depend upon just what the plate voltage is for a given tube. If we have quite a small plate voltage the characteristic curve may be such as shown in curve 1 on Plaintiffs' Exhibit No. 25. A larger voltage would produce such a curve as that marked 2.

And so on, progressively increasing the voltage would produce curves illustrated by 3, 4, 5, 6, 7, 8, 9 and so on. Each one of those separately numbered curves, in other words, illustrates a characteristic of the same tube, but taken with progressively increased plate voltages.

Your Honor will notice that as the voltage is increased the curves move to the
491 left. The curve 1, for example, is nearly wholly to the right of the zero grid voltage line on this scale on the horizontal line. The curve 9, on the other hand, is nearly wholly to the left. The efficient operation of the tube demands the Lowenstein grid bias, negative bias, and Lowenstein pointed out that as the grid bias was added the plate voltage should be increased, and it is one of the great advantages of the Lowenstein method of operation that it permits the use of the high
492 plate voltage.

Q. To interrupt you a moment, can you point out on Exhibit No. 24 what happens if a positive bias is used instead of the Lowenstein invention? A. Yes. Looking at Exhibit No. 24, at the left of the zero line it will be observed that there is only one line drawn, namely, the extension of that marked "plate current." On the right, however, another line appears marked "grid current." So as the grid potential is made positive the grid begins to act like a plate, begins to draw current. Some of the electrons go to the grid.

Q. That is, if the potential is to the right of the vertical line? A. When the potential is positive, that is to the right of the vertical line, some of the electrons go to the grid and a current begins to flow in the grid circuit, which means a current flowing in the whole input circuit of the tube. When, however, the grid is biased negative, then there is no current flowing in the grid circuit of the tube.

This is the efficient way of operating a tube 494
both from the standpoint of the general utility of the tube, and primarily of course from the point of view of freedom from input circuit distortion. We have many kinds of distortion to deal with. The Lowenstein patent has to do with input circuit distortion; this patent 1,349,252 has to do with output circuit distortion, that is, distortion arising in the tube *per se* as a result of its characteristics.

Assuming for the sake of explanation that a tube whose characteristics may be taken as represented by this Exhibit No. 25 is operated with 495
a bias on its grid equal to that denoted by the first scale division to the left of the zero line in the exhibit, a current then will flow which is denoted by the height of the point where a line projected from that scale division would intersect the curve 7. We will say that the curve 7 illustrates the plate voltage that is being used. That current would be read, in other words, on the vertical or plate current scale at the left of Exhibit No. 25, the lower division. That is the static condition of the tube.

Now I will assume that there is in the plate circuit of the tube a resistance equal or greater

than the internal resistance of the tube; and I will assume that a signal voltage is applied to the grid and that at the instant under consideration that is a positive impulse, and therefore the grid voltage is reduced.

Suppose that the actual magnitude of that voltage is such as to carry the grid voltage toward zero somewhat more than halfway, and that the current then would normally have risen
497 to a point on the curve 7 approximately opposite the number 7. That is what would happen if the tube merely had these measuring instruments across it with which the curve was taken.

But we are now assuming that there is a resistance in the external load which is as large or larger than the internal plate circuit of the tube. That resistance traversed by the increasing current will consume more and more of the B battery voltage. Therefore as soon as that current begins to increase, the tube is no longer working on the curve 7, but it is working on the curve a
498 little to the right, and as that current increases towards the full value that I have assumed it ultimately gets over to a point on the curve 6 intersected by one of the dotted lines not numbered on the diagram. In other words, that is as far as the current can go, because the voltage has now been reduced in the tube to the point where there is a balance.

If the voltage had swung in the other direction the current would have tried to come down on the curve 7 and would have come to quite a low level. But as soon as the current begins to decrease the voltage actually applied to the plate begins to increase, because less is consumed in

the external load. Therefore the voltage moves up until, for example, it agrees with that of the curve 8. So that when the current finally comes to rest it has come to that value where the dotted curve, which is higher at the right hand end, intersects the curve 8.

If we similarly locate points for widely varying signal voltages we will find that a line drawn through such points is very nearly a straight line. I will call that upper dotted line a, the 500
lower dotted line b. A marked straightening of the characteristic is obtained, and correspondingly a marked reduction in the harmonics introduced into the signal is effected. If the resistance included in the plate circuit had been still higher, the curve would have been still straighter and illustrated, for example, by that marked b.

As a matter of fact there is not much difference in the straightness of those lines. That is due to the difficulty of getting a draftsman to follow points exactly. But it is a fact that the larger the external resistance is made above that 501
equal to the tube resistance, the greater becomes the straightening effect—in other words, the greater the reduction of harmonics introduced into the signal.

This has another very striking effect. Your Honor will notice that if the operation continued on the curve 7, for example, that the signal moving a little over a half inch, say, to the left would strike a portion of the characteristic where the curvature is great. The extent of curvature indicates the extent of introduction of harmonics, and it would very soon reduce the current to zero, because the line 7 rather quickly hits the zero

axis. But the curve *a* made by a resistance somewhat greater than the internal plate circuit resistance of the tube has a straight portion extending much further to the left. So that the capacity of the tube to handle signal without distortion is greatly increased. In other words, you not only improve the quality of the output but increase the quantity of output by this relation of circuits—that is, the permissible quantity of
503 input for a given distortion or for a reduced distortion. This can be carried very far by increasing the external resistance.

The great advantages of the invention disclosed in this patent 1,349,252 are, then, that it reduces the introduction of harmonics and consequent distortion, and it extends the capacity of the tube. The negative bias is particularly effective with this proportion; for the negative bias requiring and permitting the high plate voltage makes it possible to work on a curve that is moved bodily very far to the left of the
504 zero grid potential point. In other words, the amount of negative bias that can be put on, and therefore the amount of signal that can be put on to the grid of the tube, is increased by increasing the plate voltage.

Then when the curved part to the left is straightened out by this co-ordination of Arnold we get a very wide range of operation in the most efficient operating part of the characteristic. And Arnold refers to that, and on page 1, I believe beginning at line 106. I think I have defined the terms of the specification so that your Honor will find no difficulty in following

it. I will point out what he says at that point. It reads:

> "When these adjustments have been made, operation will take place at an approximately straight part of the characteristic curve and to the left of the current axis in the region of constant input impedance, and at the same time the ratio of amplification is maintained sufficiently high." 506

That is the use of a negative bias to give the efficient amplification. I ought perhaps to call your Honor's attention to the fact that in the second column of the specification the patentee points out that when this resistance is included in the circuit the plate voltage must be raised to raise the current back to the same value where it was before.

The patentee points out that when the resistance has been added to the circuit or the resistance of the circuit has been brought up to the amount that he specifies, then in order to get the same amount of current that is found on the characteristic curve when the measuring instrument is put directly across will require a larger plate battery. So the plate battery is here increased by two factors, first the negative bias which requires an increase and, second, the external resistance in the plate circuit which requires an increase. They work together, particularly advantageously, therefore, in throwing the curve to the left and giving a wide range of distortionless operation. And this distortion- 507

less operation comes about from the distortionless input obtained by the Lowenstein invention with the distortionless external output effect produced by the Arnold invention.

When I say "distortionless" of course I am not speaking in absolute terms. There is not any such thing as absolutely distortionless, but the tendency is largely in that direction. In the case of Lowenstein it is practically wholly
509 eliminated. That is, what is left is practically altogether negatived. In the case of the output circuit one may go as nearly as he pleases to a perfect result, but never attain it.

Q. Will you now refer to Claim 15 of this patent with respect to defendant's amplifiers, all three stages being charged to infringe? A. The technical description which Claim 15 makes goes to the inclusion of an impedance in the plate circuit of the tube such as to cause the output current to vary approximately linearly—that is, according to a straight line—over a por-
510 tion of the characteristic suitable for efficient operation. That is to say, the portion to the left of the zero grid bias point.

This is illustrated in each one of its amplifiers but not in each stage of its amplifier. In amplifier A-41 it is illustrated in the tube V1. This tube has an internal plate circuit impedance of 11,000 ohms. The arrow on the diagram indicates the direction in which you are looking to find the resistance written just above it. So the primary of the transformer T1 looking at the tube sees a resistance of 11,000 ohms. On the other hand, the tube looking in the direction of the transformer sees a resistance of 60,000. It

therefore realizes from the tube V1 a very perfect correction of the tendency of the tube to introduce harmonics.

Q. That results in moving the working range to the left of the zero line in the curves to which you have been referring? A. Yes. The tube V3 of the amplifier A-36 has an internal plate circuit impedance of about 10,000 ohms, while the impedance that the tube sees looking into the transformer is about 112,000 ohms. Similarly, 512
the tubes V4, V5 have a joint impedance of about 15,000 ohms, and the tubes look into an impedance of 645,000 ohms. The tubes V6, V7 having an internal plate circuit impedance of 3,800 ohms, look into a load impedance of 5,100 ohms. In all these instances, therefore, the straight line characteristic effect of the patent is realized.

Q. Will you point out the contrast between the impedances in the amplifier PA-39 and those for example in tubes V4 and V5 of A-36? A. The tubes V4 and V5 are relatively high plate 513
circuit impedance tubes. Their joint impedance is of the order of 15,000 ohms. The tubes V6 and V7 have a joint impedance of 3,800 ohms. The tubes of the A-36 amplifier are what I have referred to as all-purpose tubes. The tubes of the PA-39 amplifier are the high current or as the art knows them power tubes. Take tubes like those of V4 and V5. They are not rated at all, as I recall, in terms of undistorted output, whereas the tubes of the PA-39 amplifier are rated in terms of undistorted current output I think 4,600 milliwatts.

Q. That is the standard curve sheets for these

514 *Frank N. Waterman—For Plaintiffs—Recalled—Direct.*

tubes point out in the case of the 250 that it is a power tube giving so many watts of undistorted power output, whereas the curve sheets for the other tubes do not refer to them as power tubes? A. That is correct. The data furnished by the engineering department of the manufacturer gives the 250 under the power amplifier and its u.p.o., or undistorted power output, is given as from 1,600 to 4,600 milliwatts,
515 depending upon the voltage at which the plate is operated. The 226 is not rated on the basis of undistorted output at all; that is, it is not given in undistorted output. The same is true of the 201-A tube.

Q. Will you now refer to Arnold Patent 1,403,475, the Resistance Capacity Coupling Patent, as to which claims 8, 9 and 10 are relied upon as to defendant's amplifier A-41? A. The circuit arrangement involved in this resistance capacity coupling patent is very simple. I think I have already defined all of the terms that are
516 used in the specification. However, it remains to explain the circuit and some of the differentiations that the patent makes.

The drawing shows a two-stage device in which the first stage is a detector and the second stage an amplifier. The two are coupled by a resistance capacity coupling in which the coupling resistance is 25. It carries the current from the battery 26, which flows through the choke 28, the resistance 25, to the plate 21, thence across the space to the filament 8 and back to the negative terminal of the battery. The alternating current in this case, the audio frequency alternating current, flows from the plate across

the filament, thence through the condenser 24 and through the resistance 25, back to the plate. The flow of this current in the resistance 25 creates a difference of potential between the ends of the resistance 25 corresponding exactly to the signal no matter what the frequency. That is characteristic of a resistance, that the voltage across it is independent of the frequency.

The voltage existing at the top of the resistance 25 is connected to the grid of the tube 31 518 by a condenser 26, and the negative bias is applied to the grid of tube 31 by a battery 30 whose negative pole is connected to the grid and whose circuit to the filament is completed through a resistance 29.

No current flows in this circuit, but it is necessary to have a connection by which the grid experiences the potential of one end of the battery and the filament the potential of the other end of the battery. This resistance 29 also prevents the interruption of operation of the tube which might occur were the resistance not present 519 due to the accumulation of electrons which might occur, because there would be no way for them to get off, they could not pass through the condenser.

A somewhat similar arrangement, your Honor will note, is found in the grid circuit of the first tube 21, but its function is wholly different in that case. The tuned transformer whose secondary is 19 and which is tuned by the condenser 20, is a radio frequency transformer. The signal is assumed to come in carried on a carrier wave of radio frequency far above any possible audibility. The radio frequency must be gotten

rid of and the audio frequency signal left. It is the function of that tube 21 to do that, and in that connection we see illustrated another wholly different function of the tube from anything which we have considered, and which I think it is not necessary to go into.

The condenser 22 and resistance 23 constitute the particular device employed to make the tube 21 act as a detector, and while they both com-
521 prise a condenser and a resistance, the effect is wholly different in this case. The specification distinguishes between the two. As referring to the resistance capacity coupling, I call your Honor's attention to page 1, lines 19 and following, and again to page 1, lines 88 to 102. The first portion of the second column of page 1 is devoted to distinguishing the action that occurs in the condenser 22 and resistance 23. Briefly, I may say that it is a question of what is known as time constant, a technical concept that we do not need to go into except to point out that it
522 calls for different proportion of those devices.

Q. What are the advantages of this arrangement? A. The great advantage of the resistance capacity coupling is its entire independence of frequency over a very wide range—the whole range of voice frequencies handled with practically identical efficiency. It also is of great advantage in these days of particularly low-priced radio sets, in its cheapness and also in its compactness in the sets where a lot of amplifier machinery must be gotten in a very small space. It is also particularly adapted to the coupling where the energy is small. For example, in an amplifier for talking motion pictures where the

signal is taken from a film and converted into current by a light beam in a photo cell, the current that is given off is excessively small. So that to try to do it by transformer or any other means of coupling would be a matter of very great difficulty and accomplished only inefficiently.

Q. Do these remarks have any relation to the defendant's circuit? A. Yes, they are specifically illustrated in the defendant's circuit, where the 524
tube or photo cell which receives the beam of light passing through the film furnishes an exceedingly small current which passes through the resistance K. The difference of potential created in K is passed on to the grid of the tube V1 through the condenser C1, and the bias for the grid is applied through the resistance L. With these factors as given here on Exhibit No. 2 the time constant of that organization is something over three seconds, if I recall, showing that there will be no frequency discrimination over even a wider range than it is possible 525
to use in the transmission of voice and music.

Q. Do the claims in suit 8, 9 and 10 read on this description? A. Yes, they are descriptive of the arrangement. Claims 8 and 9 mention only the resistance K and condenser C1 in Exhibit 2. Claim 10 recites also the resistance corresponding to resistance L.

Q. Will you now refer to Arnold patent 1,448,550, the definite input impedance patent, of which Claims 1 and 12 are relied upon as to defendant's A-41 amplifier. A. The impedance that the input circuit would see looking into an audion may vary over a very wide range. If

the grid had a positive bias it might be very low. With a negative bias, on the other hand, the input impedance of the tube itself is practically infinite.

From the point of view of minimizing or substantially eliminating the distortions occurring due to flow in the external circuit, the negative grid bias is very perfect. And applied to a telephone line, however, the line looking into the
527 tube will sometimes see a very curious thing. It will think it sees a reflector, and the image will be reflected back in the line. That may produce an echo, so that the speaker at the far end of the line hears his own voice coming back to him a little later. It may serve to upset receiving amplifiers where there is a long line with a succession of amplifiers.

There is another effect. When the transformer secondary which is connected to the tube looks into the tube it sees not only the infinite impedance from a conductive point of view, but it
528 sees the little condenser which is constituted by the grid and the filament.

That taken in conjunction with the inductance of the secondary of the transformer may act like the balance wheel in the hair-spring of a watch.

By the Court:

Q. Would you mind stopping long enough to define "inductance" in plain terms? A. In alternating current circuits, we have two sources of impedance which are different from resistance; the one is known as the reactance of the con-

denser. The other is known as the reactance of the inductance. When the current flows, there is created a magnetic field; when a potential exists, there is created a static field. Those two fields have their own kick-backs, so to speak, the magnetic field changing through a coil of wire produces an impeded effect and the current flowing in proportion to the intensity of the magnetic field to the number of turns the wire influences. The inductance of the coil, therefore, is the num- 530
ber of turns times the flux change per unit of current flow, or as we say, flux turns per M per M.

Your Honor can think of it with perfect accuracy by thinking of it as a magnetic field change in each coil due to a change in current and that changed magnetic field produces in the coil an impedance to the flow of current.

Q. Impedance is induced by the magnetic field? A. By the magnetic field, yes. That is what we mean by inductance.

Q. Now, just where does that inductance arise 531
in this? A. In the transformer is a large number of turns of wire wound on an iron core, the secondary of that transformer 5 of Patent 1,448,650.

The Witness: It is the coil to the left side of the figure, but to the right side of the transformer.

The transformer 5 is the input transformer; the right-hand coil of that is the secondary coil. Now, it is possible for that transformer acting with the capacity of the tube to get into a state of oscillation—I mean a state of resonance, I beg your pardon, wherein at a particular frequency the impedances due to the inductance and

to the tube capacity disappear and the transformer becomes enormously receptive to frequencies of that value, so that it is possible for the resonant effect produced to pick out and exaggerate one frequency. Then there is another difficulty that may arise in any amplifier. It is extremely difficult to so dispose of the parts in all the wires that there shall be no magnetic fields or electrostatic fields reaching
533 over from the output to the input side. If that happens to a sufficient extent, it may set the whole system oscillating like the balance wheel and the hair-spring of a watch. It then becomes a generator, overloads the tube with its own oscillatory current and produces various disastrous effects. If it does not go that far, it may go to the extent of greatly increasing the amplification and of changing the normal frequency characteristic of the transformer. The transformer design in audio frequency amplifiers, is a matter of great difficulty. The trans-
534 former tends to work at a particular frequency and all of the powers of an electric designer have to be exercised to get a transformer which will have broad frequency characteristics. The tendency resulting from the feed-back just mentioned, is because the transformer is to be selected for particular frequencies. All of these effects are cured or minimized by putting across the secondary of the input transformer a resistance chosen of proper value to effect the cure of the particular defect experienced.

The tube then looks to the transformer and the incoming line like a definite load of that value selected with a desired end to be attained

and used and this patent therefore is known as the Definite Impedance Patent.

The specification discusses the varying nature of the input impedance of the tube, and suggests that the resistance 6 may be of the order of 500,000 ohms as a suitable value for most cases, or a range from 100,000 to 1,000,000 ohms.

The resistance serves to prevent reflection by absorbing the energy that might otherwise be reflected. It serves to prevent or minimize the resonance effect by absorbing the energy which would otherwise go into the resonance phenomenon. It prevents or minimizes the effect of feedback from the plate to the input circuit, by again absorbing the energy fed back.

Claim 1 of the patent goes particularly, so far as technical description is concerned, to the resistance connected across an inductive input. The transformer is an inductive device; its secondary coil is an inductive coil connected across the input circuit. Resistance is connected across its terminals. That is, in substance, the recitation of claim 1.

By Mr. Ashton:

Q. Will you point out the elements corresponding to these in the defendant's circuit? A. It is found in the amplifier A-41 in which resistance of 550,000 ohms connected across a secondary S1 of the transformer T1.

Claim 12 goes to a tube having a practically infinite input impedance, that is, one having a negative bias, and by the way, I should have pointed out that the values, particularly the

value of 500,000 ohms, which the patentee recites, is with the understanding that the tube has a negative bias.

Claim 12 goes to this combination of a definite input impedance of the order of 500,000 ohms, with a tube having a negative bias, that is, of having an infinite input impedance.

The tube that I just pointed out, S-2, across which the 550,000 ohms is connected, has an in-
539 finite input impedance given to it by virtue of the bias derived from the filament current resistance flowing through the resistance R-2.

Q. Will you now refer to Arnold Patent 1,465,-332, the Common Plate Supply Patent, as to which claims 3, 8, 10 and 11 are relied upon as to the A-41 amplifier; and claims 1, 3, 5, 10 and 11 as to the A-36 and P-32 power pact. A. This patent goes to the operation of a plurality of amplifying tubes arranged in tandem or cascade connection on a common battery, that is a common plate circuit battery. In such a tandem am-
540 plifier, the signal comes into the first stage, as for instance by the wires, 16, 17, which is amplified by the first tube, as for example the tube 10, passed on in considerably amplified form to the next tube, such as tube 11, and again passed on in further enlarged form to whatever apparatus is connected to the output of the second tube. These all have currents of widely different energy, magnitudes are therefore flowing in the output circuits of these two tubes. The problem is nevertheless to supply them from a common source of space current without their interfering with one another.

Referring to the drawing, battery 20 is shown

as supplying the space current for both tubes. The positive terminal is connected through a choke coil 21 and through the primary 22 of the transformer with the plate circuit of the tube 10, the current returning from the filament to the minus terminal of the battery 20. Similarly the tube 11 is supplied from the positive terminal of the battery 20 through the coil 28 and coil 29, to the plate 14 of the tube 11 and from its filament returns to the ground connection 30 542
and thence by way of ground to the ground connection 31, which is at the negative terminal of the battery 20.

Q. You can regard those ground connections as though wires were connected between them? A. Exactly. That is a mere matter of convenience.

If the two plate circuits were connected directly to the battery without any protecting means, then what would necessarily happen would be that all of that portion of the alternating current of the tube 11 which flows through 543
the coil 29,—and there must be enough to flow through to keep the rest out, otherwise there would be no point in the coil 29,—all of that part flowing through 29, I say, would have to pass through the battery 20; and then by way of ground connections to the filament. But there would be then the plate circuit of the tube 10 also directly crossing the battery and also forming the path for this plate current of tube 11. The result would be that the alternating current from the tube 11 would flow through the plate circuit of the tube 10, and the result of this would be to produce regeneration in the tube 11,

which might be great enough to set the whole amplifier into a state of oscillation, or as it is called, singing.

Q. Would you please explain the term "regeneration" a little more clearly to the Court? A. As I have expressed it in other terms heretofore, it implies the passing forward of energy from the output circuit of the tube into its input circuit. All of the energy of the tube 11
545 which gets into the battery 20 thereby gets into the output circuit of the tube 10; but everything that is in the output circuit of the tube 10 is for the purpose of the amplifier, necessarily made to affect the input circuit of the tube 11. Therefore we would have direct provision for the flow of output current from tube 11 back by way of tube 10 into the input circuit of the tube 11. It would there be again amplified and again passed back, with the result that there we would get what is known as regenerative amplification, which, as I have already pointed out tends to
546 destroy the effect of the transformer or it might go to the extent of causing the system to oscillate. In order to prevent any such action from reaching large amplitude, Arnold places across the plate circuit of each of the tubes a condenser 23, in the case of tube 10 and 32 in the case of tube 11; alternating current from tube 11 which passes through 29 is given a short, easy path back to the filament through the condenser 32.

Q. Alternating current from tube 11— A. Alternating current from tube 11 passes through 29 and is given an easy path to the filament through the condenser 32 and does not have to pass through the battery, and the interposition

of the choke or inductance coil 28 is for the purpose also of imposing a difficulty in the path of the alternating current from flowing in the wire that leads back to battery.

By the Court:

Q. It tends to divert traffic at that point? A. It tends to divert traffic, that is it exactly, yes. He also shows a similar arrangement in the circuit of tube 10. 548 The alternating current of tube 10 is kept out of the battery by 23 and if any of the alternating current from the tube 11 is diverted, for example, due to a cell going bad in the battery 20 and so goes up through the plate circuit of the tube 10, it is first invited to stay in the battery circuit by the impedance imposed by the coil 21 and it is then given an easy path through the condenser 23, so as to side-track it and prevent its going through into the plate circuit of the tube where it really would do damage.

549 Those are the means adopted to make practical the operation of the tube from a common source. It is commonly found that the mere use of the condensers is enough, or even one condenser is enough, sometimes just one choke is used, maybe in either of the positions shown; sometimes the whole combination is used, according to the severity of the conditions that are imposed.

Claim 1 goes, technically speaking, to the use of one inductance and one condenser and one tube.

Claim 3 goes broadly to means, whether one

or more condensers and whether with or without inductance.

Claim 5 goes to one condenser and one inductance, which may be in the same or different circuits.

Claim 8 goes to a condenser across each plate circuit to each tube.

Claim 10 goes to filter connections between tubes, the elements of the filter are not specifically stated. To define that term "filter" I call your Honor's attention to the fact that such a discriminating combination of inductance and capacity or capacity only, or inductance only, is broadly a filter. It tends to separate currents of different frequencies.

Claim 11 is similar in that respect to claim 10.

Q. Will you refer now to the application of this invention in defendant's circuit A-41 amplifier first? A. Referring to the amplifier A-41, each of the plate circuits of the tubes V and V2 is provided with a condenser from the lower end of the transformer primary directly back to the terminal. Thus the condenser C2 is connected to the primary end, of primary P1 and goes directly back to the filament of the tube V1. It thereby affords a short and easy path for the alternating current to flow locally in the tube to transformer and condenser C2. Similarly condenser C3 connected in an identical manner affords an easy local path for the alternating current for the tube V2 and transformer primary P2 and condenser C3, thus minimizing the amount that can get into the B battery.

Q. To which elements in the patent do these

condensers correspond? A. They correspond to the condensers 23 and 32 of the patent.

In the intermediate amplifier A-36, we have in the plate circuit of the vacuum tube V3 a choke coil G1 with the condenser C4, and choke coil G1 is interposed between the source and feed coil G2, which corresponds to 29 in this patent.

In other words, this is a parallel feed tube just as the tube 11 of the patent is a parallel feed tube, and in coming from the source, we go first 554
through the choke 28 in the patent, then through choke 29. So in this instance, we go through a choke G1 and then through choke G2. The condenser C4 corresponds to condenser 32 and it is tapped off from the plate lead between the two chokes G1 and G2, just as the condenser 32 is tapped off between 28 and 29 in the drawing. The two tubes V4 and V5 are operated in what is known as the push-pull relation, which means that from the point of view of the alternating current, the tubes are in series, so that the alternating current output may be conceived of as 555
flowing from the plate, say, of the tube 4 through the filament system, through the tube V5, through the transformer and back and carried on in the direct current as alternating current superposed. Therefore if the two systems operated ideally, there would be no alternating current flowing from the source at all. Direct current would flow from the source and the middle point of the transformer primary P5 dividing the flow through the tube; the alternating current would be superposed thereon and would, in effect, be purely local. However, such balance

of the tubes rarely happens. The tubes never perform identically, even though meant to be identical. The result is that some alternating current tends to flow in the direct current lead.

Choke coil G3 is interposed in that lead to minimize any alternating current from flowing in the common supply system which might thereby get back, but this flow is prevented from getting back by the combination of G1 and C4.

557 The condenser corresponding to 32 does not exist in the amplifier but only the choke G3 corresponds to choke 28.

The amplifier PA-39 has only one stage for the source, so the disclosures of the patent do not apply to it.

Q. Will you now refer to the Arnold Patent, the last patent, No. 1,520,994, "Gain Control Patent," of which claims 1 and 4 are relied upon as to the A-41 amplifier. A. This patent goes to the control of the amplification of an amplifier without changing the impedance that

558 the amplifier presents to the line and without altering the operating characteristics of the tube or its relation to its circuits. All these things are important factors in the determination of the freedom from distortion that this type of amplifier has. What the patent shows is a means of controlling the gain without influencing any of these factors, which consists simply in the use of a potentiometer 25, whose variable connection 26 is connected through the biasing battery to the grid and filament elements of the following tube.

A potentiometer is, in the sense in which I use it, and its usual significance is a resistance pro-

559

vided with means for making connections to its ends and also to the variable points between the ends. It is commonly known also as a voltage divider.

Resistance 25 is connected across the secondary 24 of the intermediate transformer, and the patent states that between stages in that area is a very advantageous place to put the gain control.

The grid 13 of the tube 11 is connected to the 560
movable contact 26 which may be adjusted anywhere along the resistance. I have explained to your Honor that whenever the source of voltage is connected across an external load device the entire voltage of the transformer will be, or the source will be dissipated somewhere or other in that load, so the entire alternating power voltage of the secondary transformer 24 is distributed along that resistance 25, therefore, by moving the point 26, any part of it may be taken off, because the filament connection is fastened to the bottom, therefore, if point 26 were 561
to be at the bottom end, then no voltage at all would be taken to the grid and we would have no output. If we moved it to the top, then we would have maximum output. Any output between can be attained. At the same time, the circuit constants are maintained entirely as desired by the selection of the original value of the resistance 25. In other words, it becomes the definite input of the patent and similarly any alteration that is made in the relation between the output impedance of the tube and its internal impedance and therefore neither the energy relation established by the designer or

the straight line characteristic relation established by the designer is altered by that mode of control or gain. The specification points out at page 1, line 90, that a negative bias is necessary for the application of this method of grid voltage control, as otherwise the variable impedance of the input circuit of the tube would alter the impedance of the combination of potentiometer and tube as seen from the trans-
563 former secondary.

The specification points out in the second column on page 1, various advantages, as for example, it permits the interchange of tubes. No, that is another patent I am thinking of. No, that is not pointed out, but it is true nevertheless, it permits the interchange of tubes without affecting the character of the amplification.

Q. Is the invention defined in the two claims relied upon, 1 and 4? A. Yes. Claim 1 goes to the combination of the input circuit with impedance in shunt, as for example, impedance D
564 in the secondary transformer T1 of amplifier A-41 and means comprising a contact movable along said impedance for effectively controlling electrode B1 with any desired potential point on the resistance D1 that is being affected by the contact Q1.

Q. The reference to "shunt" means connected across the input circuit? A. Yes.

Q. Does claim 4 bring in negative bias? A. Yes, claim 4 brings in negative bias in addition to the element specified in claim 1.

Q. I direct your attention again to the Arnold Straight Line Characteristic Patent 1,349,252, and ask you if you have any authority to which

you would wish to refer as to the invention of this patent? A. I have in mind the work entitled, "Thermionic Vacuum Tube," by Van Der Bijl, which has been the standard authority on vacuum tubes since its publication in 1920. On page 170 of this book, after treating the subject mathematically, the author says:

> "This is the equation for the characteristic of the circuit consisting of the tube 566
> and resistance r_o, and it will be seen, if I_p be plotted against E^1r, for various values of r_o, that the curvature of the characteristic is reduced as r_o is increased, the characteristic becoming practically linear when r_o is equal to or greater than the plate resistance. This is an important result for which I am indebted to my associate Dr. H. D. Arnold, and has an important bearing on the problem of distortionless amplification of telephonic currents." 567

Q. Is Van Der Bijl referring to Dr. Arnold, the patentee of this patent in suit? A. Yes.

Q. Do you have any other person in mind who has referred to the advantages of this Straight Line Characteristic Patent? A. Dr. Lee De Forest, the inventor of the three electrode audion, in one of his articles published in the journal of the Franklin Institute for July, 1920, at page 10 of the article, the top of the page, says:

> "Consequently we find telephone engineers going to extreme lengths to so

568 *Frank N. Waterman—For Plaintiffs—Recalled—Direct.*

design their audions and circuits, and to so regulate the potentials applied to the grid, as to operate entirely within this straight line characteristic. The result is a perfect reproduction of voice currents, but magnified to any extent desired by the use of two or more such amplifiers connected in cascade—from ten to twenty thousand times or more."

569 Q. Does Dr. De Forest also refer to power tubes which were an element in the claims of the Patent 1,329,283, the Power Circuit Patent? A. Yes, he refers to the 1915 tests of the Western Electric Company on page 21, where he says after referring to preceding work:

"Such rapid progress was made in improvement of design and construction of these so-called 'power tubes,' notably by the engineers of the Western Electric Co., that by autumn of 1915 a bank of several
570 hundred tubes, their input and output electrodes connected in parallel, were installed at the Arlington wireless station."

Q. Does he also refer to the invention of the Lowenstein patent on page 28? A. He refers a number of times to the use of the Lowenstein invention.

Q. I direct your attention to the first paragraph. A. The first complete paragraph on page 28 says:

"The audion which has been evolved to meet these requirements, most rigorous of all its numerous applications, differs in

many details from the detector or the oscillating audion. The presence here of gas ionization sufficient to cause appreciable distortion cannot be tolerated, neither must the grid be permitted to be positive at any phase of the cycle of impressed voltage. A hundred other minor requirements, small yet difficult of realization, have been patiently achieved by our telephone engineers, who now state that 'the amount by 572
which it (the audion amplifier) fails to meet all the requirements for a perfect repeater is so small as to be negligible except under the most rigorous conditions.' "

Q. Does Dr. De Forest also refer on page 25 to the audio amplifier and repeater work of the Western Electric Company? A. Yes, after discussing the various circuits he says, at the bottom of page 25:

"The development by the engineering 573
staff of the Western Electric Company of the audion amplifier as a telephone repeater since my first demonstration to them of its possibilities in that field, are beyond all praise. The zeal and rare understanding of the elements of the problem with which this staff of trained men developed the amplifier and applied it to the long-sought transcontinental telephone line stand unique in the annals of brilliant achievement in electrical engineering."

Mr. Ashton: I offer in evidence a copy of Dr. DeForest's paper from the journal

of the Franklin Institute, Volume 190, July, 1920, No. 1.

Mr. Darby: I object to its receipt in evidence, because everything that is apparently pertinent has been read into the record already. It just encumbers the record.

Mr. Darby: If you agree to treat it as a physical exhibit, I shall withdraw my
575 objection.

The Court: That is very nice, thank you.

Mr. Darby: I would like to record on the record my objection as to its materiality.

The Court: I think it probably goes to the weight.

Mr. Darby: Yes, your Honor.

The Court: Objection overruled and exception.

(Marked Plaintiffs' Exhibit No. 26.)

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By Mr. Ashton:

Q. Will you state some of the uses to which the various types of vacuum tubes contained in the defendant's amplifier have been and are being put? A. Substantially the uses that I have mentioned for the amplifiers. I do not know that this particular number of tubes are used in wire telephony, but tubes of similar characteristics are employed, and of course, there are other fields, also tubes of similar characteristics are employed, particularly the power type tubes, which are used in railroad signaling and in au-

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tomatic train control where they have a considerable field and for various laboratory purposes their uses are extending all the time.

Q. Do you have in mind 201-A, 227, 226, 250 and also the 280 and 281 tubes? A. Yes, except that I do not want to be understood as saying of my own knowledge that those particular tubes are used in wire telegraphy or wire telephony, but tubes of analogous character are.

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Cross Examination by Mr. Darby:

Q. How long have you been familiar with the use of those respective tubes of analogous character? Over a considerable period of years? A. Oh, yes.

Q. They have been readily available in the open market, have they not? A. For a good while, yes.

Q. In other words, there are retail stores scattered throughout the United States in which tubes of those characteristics can be purchased across the counter? A. There are and have been for some time, yes.

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Q. You made reference to an authority of Dr. Van Der Bijl; I did not hear you give the date of publication of that book. A. It was 1920.

Q. Who is Dr. Van Der Bijl? A. He was a research engineer in the Bell Telephone Laboratories, I believe. He has not been associated with them, if I am correct, on my information, for a great many years, and I don't know what his connection is now.

Q. You know that he was associated with the Bell Telephone Laboratories at the time he wrote

the book, do you not? A. Yes, at the time the first edition came out, he was.

Q. Now, with reference to the defendant's apparatus, that apparatus, just as it is shown there, has an amplifier that can be used for any one of a number of purposes, that you mentioned, namely, in connection with wireless telephony, wire telephony, public audition systems or sound systems in connection with motion pic-
581 tures, can it not? A. Well, I don't know that that is quite so. There are three units there, and, of course, various other units are made, and those are selected, the particular units to be used, are selected for the particular purpose that one has in mind. Broadly speaking, I should think that the proposition may be assented to. However, probably it might not be chosen for all those purposes.

Q. You have all the dimensions given there; is there any reason that you can advance why that particular instrumentality could not be used as
582 an amplifier in connection with radio work? A. Well, certainly not without slight alteration, but it could be adapted to radio work.

Q. Are you familiar with the particular apparatus of which that wiring diagram was taken? A. No, I have not used that particular apparatus. I am familiar with apparatus of that kind.

Q. Have you seen that particular apparatus? A. No, I have not seen that particular apparatus.

Q. Then, you do not know of your own knowledge whether that particular apparatus is sold for use in connection with radio broadcast reception? A. Why, the units undoubtedly may have been. I have no intention of saying that the

units could not be used in radio. I merely mean that the organization has to be adapted to radio.

Q. What change in adaptation would be necessary? A. Well, at least suitably to change the input circuit.

Q. By that you mean to eliminate the photo-electric cell? A. Yes, and make suitable coupling and suitable radio circuit.

Q. Do you see any other changes of adaptation that would be required other than perhaps con- 584
necting to a loudspeaker or something of that kind? A. I think the units could be adapted to the circuit. I do not think anyone would use it just as it stands.

Q. I see. Can you give me a brief workable definition of "impedance"? A. Well, yes. It perhaps depends on what you have in mind. Impedance is that which impedes the flow of alternating current.

Q. And can you enumerate the types of impedance that are ordinarily used in vacuum tube
circuits for that purpose? A. The reactance of 585
inductances of various types. The reactance of condensers and resistances.

Q. As a matter of fact, every wire has a certain amount of resistance, has it not? A. Certainly, yes.

Q. And to the extent that any conducting wire has that amount of resistance, that wire imposes an impedance equal to the resistance of the wire, is that right? A. Yes, certainly.

Q. Now, in determining the internal impedance of a vacuum tube, will you please enumerate the factors that control that? A. You mean the factors that control the method of measurement?

Q. No, the factors which control the make-up of impedance. A. Well, answering your question as broadly as you stated it, one would have to say all the factors that go to the operation of the tube.

Q. And they are what? A. Temperature of the filament, the nature of the grid, the nature of whatever sources are connected to it, structure of the plate, the space relations of all of the ele-
587 ments, voltage supplied to the plate.

Of course, the nature and quantity of emission of electrons from the filament. I do not mean by that to say that there are electrons of two natures, I mean the nature of the filament and the quantity of emission from it.

Q. When you say the nature of the grid, by that do you mean the size of the wire constituting the grid or do you mean to include that? A. The size of the wire and space of the wire.

Q. You mean spacing between the various turns in it? A. Yes.

588 Q. When you say the structure of the plate electrode, you mean to include the thickness of the plate? A. No, the thickness is not an element. It is the area and its spacing which are the two essentials.

Q. Is one of the factors the spacing between the grid electrode and the plate electrode? A. Yes, although that is more concerned with the amplification factor than it is with the internal impedance. It is more particularly the distance between the filament and the plate that is of prime importance in determining the internal resistance.

Q. Is the spacing between the grid electrode

and the filament electrode one of the factors? A. So far as I know, that does not enter into the plate circuit resistance, if the spacing of the plate and filament are not thereby altered. I am not sure about that, Mr. Darby.

Q. Finally on that subject, is the degree of evacuation of the tube one of the factors? A. Yes, if the evacuation is low enough so that the working velocities of electrons are sufficient to produce gaseous ions to a notable extent, then 590 the resistance is enormously affected.

Q. Can you tell me, in radio circuits or vacuum tube circuits, what is considered to be meant by the term "high resistance"? In other words, where is the dividing line between high resistance and low resistance? A. Well, the so-called high mutuals I think might be classed as having internal plate circuit resistance of the order of, oh, 50,000 ohms up to several hundred thousand. The all-purpose tubes run around 8000 to 12,000, and the power tubes, I think the smallest of them go as high as 4000 or 5000 ohms. 591 The more generally used tubes are 2000 ohms or less.

Q. Which of those would you call high? A. Those that I mentioned first, I would call high; the next ones are intermediate and the power tubes are ordinarily considered as low resistance tubes.

Q. The ohm, of course, is the unit of resistance? A. Yes, sir.

Q. How many ohms equal a megohm? A. One million.

Q. What is meant in this art by the expression "attenuation"? A. It refers to a weakening of

the signal applied particularly to long lines where distributing inductance and capacity enter. I could illustrate that by a statement that used to be quite frequently made, that is, if you have a line reaching from New York to San Francisco, you could not put power enough in the New York end to get a message through to San Francisco, because of the attenuation of the cable.

593 Q. Is attenuation one source of distortion? A. Yes, that is partly what Lowenstein has in mind in the first column of the page 1 of the patent.

Q. Now, referring again for the moment to the matter of the spacing between the grid electrode and the filament electrode, has the distance of the grid from the filament any important bearing on the function of the tube for the purpose of obtaining voltage amplification? A. The theoretical formulae, as I recall them show that it has an effect, but is less important than the space between the grid and the plate.

594 Q. On the question of distortion, how many kinds of distortion are there? I am informed there are three kinds, namely, frequency distortion, harmonic distortion and phase distortion; do you agree with me on that? A. That is one way of classifying them, yes.

Q. Those three kinds of distortion— A. There may also be intensity distortion.

Q. Intensity distortion? Now, in connection with vacuum tube amplifier, an illustration of the frequency distortion, is where the vacuum tube will amplify one or more frequencies of a class greater or less than it amplifies one or more

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frequencies of a different value, is that right? A. Yes.

Q. Now, can you give me a similar brief illustration of the harmonic distortion with the vacuum tube amplifier? A. Well, I take your expression to mean that the tube may introduce frequencies which were not contained in the signal originally, in view of its own operating characteristics, and so produce frequency distortion.

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Q. That is right. Did you intend that as an answer to my last question? A. Yes, isn't it?

Q. On the harmonics? A. The tube introduces harmonics. In view of the nature of this characteristic, it may impose second, third, fourth or even fifth harmonics on the signal.

Q. I do not know whether the Court has clearly in mind what is meant by "harmonic." Can you give a simple definition or illustration of it? A. I meant by using the term harmonics, multiples of the fundamental frequency.

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Q. Can you give me an equally simple illustration of phase distortion? A. I do not know that phase distortion occurs in the tube itself. It is rather the result of the whole organization. The various component frequencies that go to make up sound are related in three ways. First, as to their relative frequencies, second as to their relative intensities and third as to their relative phase. The phase distortions that I assume you are referring to, are more commonly the result of the circuit. They necessarily enter in it somewhat where the tube introduces harmonics.

Q. You added to my original three, the intensity distortion. Can you give me a simple il-

lustration of that? A. It sometimes happens that phase distortion of tube and circuit will amplify feeble signal more than a signal of greater intensity, therefore, the relative proportions of the components, both instantaneously and with time, may not be preserved.

Q. You referred a moment ago, in cross examination, to formulae with which you were familiar in connection with the subject of voltage
599 amplification and the spacing of the grid from the filament. I show you a formula in Professor Morecroft's book entitled, "Principles of Radio Communication," page 384, and ask you if that is the formula you have referred to?

Mr. Ashton: What is the date of the book, Mr. Darby?

Mr. Darby: I don't know. Will you give us the date, please?

The Witness: Copyrighted 1921. No, that is not the formula I had in mind, and
600 the distance between the grid and filament does not appear in it at all.

The Court: What is that book?

Mr. Darby: Professor Morecroft's book "Principles of Radio Communication."

Q. Now, will you please refer to Plaintiffs' Exhibit 2, defendant's apparatus and taking up first the amplifier A-41, will you please state whether the exterior circuit connected to the grid and filament elements of the tube V1 has a greater or lesser impedance than the external circuit connected to the plate and filament electrodes of that tube? A. I did not get the first part of that. Will you please read the question?

(Question read.)

A. A greater impedance.

Q. Now, with respect to the tube V2, has the external connection between the grid and filament a greater or lesser impedance than the internal connection between the plate and filament of that tube? A. Greater.

Q. Going to the intermediate amplifier A-36, will you answer the same question with respect to the input circuit of the tube V3? A. Greater.

Q. That is, the input circuit has greater impedance than the output circuit, is that right? A. As I understand it, yes, sir.

Q. Now, with respect to the tubes V4 and V5, will you answer the same question? A. The input circuit has the smaller impedance, as I understand it.

Q. Will you answer the same question with respect to the tube V6? A. The input circuit has greater impedance.

Q. Now, will you please refer to the patents in suit, in each instance in defendant's apparatus where the negative bias is employed, the particular means for effecting the negative bias is not the means illustrated in the drawing of the Lowenstein patent, that is correct, isn't it? A. It is.

Q. Now, if you will refer to the Mathes patent. In the illustration of the Mathes invention the negative bias on the grid is obtained from the source of current utilized to heat the filament; is that correct? A. In Figs. 1 and 2; that is right.

Q. How about Figs. 3 and 4? A. It is not obtained from the filament current in that instance.

Q. What is the source of negative bias on the grid in Figs. 3 and 4? A. The battery 7 sends a current through the resistance 9, and the drop in that resistance is the source of the bias.

Q. And in each of the figures the negative bias imposed upon the grid of the tube is effected by a resis[illegible]e that is connected in series circuit
605 connection with the filament; is that right? A. No, not if you mean in the heating circuit of the filament.

Q. That is true with respect to Figs. 1 and 2, is it not? A. Yes.

Q. Now, with respec[illegible]'o Figs. 3 and 4, I understood you to say that the drop in potential across the resistance is what impressed the negative bias on the grid? A. That is correct.

Q. Which resistance are you talking about? A. The resistance 9. That resistance is not in the filament heating circuit.

606 Q. That is, however, in the connection between the grid and the filament? A. Yes.

Q. If you will refer to Arnold Patent 1,329,283, which has been described as the power circuit patent. Whether or not one utilizes what is selected as the invention of this patent depends upon the internal impedance of the vacuum tube employed; is that not correct? A. I question very much whether you could accurately express it that way. It is rather the organization of the whole circuit, such that the tube resistance and the circuit resistance are of the same order.

Q. And if the impedance of the output circuit

is of a certain value, then the impedance, internal impedance of the tube, would be of the same order; is that right? A. If the organization corresponded to the disclosure of the patent as referred to in the particular claims in issue, yes.

Q. Therefore, in determining whether or not the claim combination or combinations of the claims in issue were being utilized by any particular instrumentality it would be necessary for you to know the external impedance in the output circuit of the tube as well as the internal impedance of the tube; is that right? A. Yes. 608

Q. Will you please refer to Arnold Patent No. 1,349,252, which has been described as the Straight Line Characteristic Patent. The instrumentality which has been selected to illustrate the asserted invention of this patent is a resistance connected in the plate circuit of the vacuum tube; is that right? A. I think that is hardly clear. I pointed out that in Fig. 3 a resistance has been inserted in addition to the indicated useful load circuit, whereas in Fig. 5 the resistance itself is in the useful load. 609

Q. And the patentee's description of Fig. 5 is contained on page 2, lines 5 to 24; is that correct? A. Yes.

Q. And the patentee states that his invention can be utilized by carrying into the output circuit the effect of a resistance contained in a coupled circuit; is that correct in substance? A. Yes.

Q. So that the means selected by the patentee to illustrate his invention is the utilization of a resistance either connected in the output circuit or imparted to the output circuit from an outside

source by suitable coupling; will you accept that statement? A. Yes, I think that is a fair statement, provided that it is not in conflict with what I said before, namely, in Fig. 5 of the resistance R is the load or perhaps it is R^1 that is the load, and it is whatever resistance the load itself imposes.

Q. In other words, the point that you are making is that there must be something more than
611 merely the resistance itself; is that right? A. Yes.

Q. The resistance must be added to its normal load? A. No, in Fig. 3 he shows a resistance added; in Fig. 5 the resistance is the load. That is whatever load is there as the resistance.

Q. Turn to Arnold Patent No. 1,403,475, which has been characterized as the Resistance-Capacity Coupling Patent. What there is in this patent illustrated to show the asserted invention—that is, as defined in Claims 8, 9 and 10—is a resistance connected between the plate and filament
612 circuit of one tube and a direct connection through a capacity or condenser to the grid of the succeeding tube; is that right? A. Those are the elements referred to in Claims 8 and 9. Claim 10 also refers to the resistance 29 through which the biasing connection is made.

Q. Now if you will refer to the Arnold Patent No. 1,448,550, given the name Definite Input Impedance Patent. What has been utilized by the patentee to here illustrate his invention is an impedance connected in shunt across the input transformer of a vacuum tube amplifier; is that right? A. Yes.

Q. Now in calculating impedance of a circuit

you include the values of the condensers and the inductance coils and the resistance, the choke coils, in that circuit, do you not? A. If that is what you want to know.

Q. If you want to know the impedance? A. The total impedance, yes.

Q. A question by the Court induces me to go back and retrace my steps a bit, Mr. Waterman, if you do not mind. Arnold's Patent 1,329,283. Referring to Fig. 7 of the patent, for example, 614
would the resistance 6 connected across the input line be taken into consideration as an impedance if you were calculating the input impedance? A. Yes, if you are calculating the impedance that the tube looks into you would include the resistance.

Q. The output circuit includes the condenser 9 and the choke coil 8 and the receiving device 10. In determining the impedance of the output circuit each one of those elements would play its part in determining the impedance, would it not? A. Yes, you calculate the impedance of the net- 615
work. That is stated at the top of the second column, page 2.

Q. Maybe we can dispose of it with this general question. If you are going to determine the true impedance of an output circuit you determine the impedance of every instrumentality that is in that circuit, do you not? A. Yes.

Q. Taking this next Arnold patent, which is 1,349,252, the Straight Line Characteristic, the resistance element which the patentee uses to illustrate the application of his invention, is the resistance marked R in Fig. 3 and the resistance marked R^1 in Fig. 5; is that right? A. Well, I

am not quite sure that it is. As I understand it in Fig. 3 R is the resistance illustrating a way of bringing the resistance of the output circuit up to a value equal to the internal resistance of the tube or greater. Of course it would be the same thing if it were in the load. Now in Fig. 5 it is the entire load.

Q. Then it is your understanding that what Arnold is doing in this patent is to bring the
617 total impedance of the output circuit to a point where it is equal to or greater than the internal impedance of the tube; is that right? A. Yes.

Q. And in Fig. 3 he adds a resistance to the output circuit for that purpose, and that resistance is R? A. Yes.

Q. And in Fig. 5 he has a load or if necessary adds a resistance R^1 of the desired amount, to bring it up to the internal impedance of the tube; is that right? A. Either could be done. He shows the first.

Q. Going again to Arnold Patent 1,403,475, the
618 Resistance Capacity Coupling Patent, the instrumentalities that we reviewed just a minute ago, utilized by the patentee to illustrate his asserted invention as defined in Claims 8 and 9, are the resistance 25 and the condenser 26; is that right? A. Yes.

Q. And the instrumentalities utilized by the patentee to illustrate the invention as defined in Claim 10 consist of the resistance 25, the capacity or condenser 26 and the resistance 29; is that right? A. Yes.

Q. If you will please turn to the Arnold Patent 1,465,332, which has been called the Common Plate Supply Patent. The common current sup-

plied for the plate electrodes of both of the tubes shown is the battery 20; is that right? A. It is.

Q. And the series inductance as used in the claims of that patent in suit comprise the inductance coils 21 and 28; is that right? A. Yes, each of those is a series inductance.

Q. And the bridging capacity referred to in the claims in suit is illustrated by the condensers 23 and 32; is that right? A. Yes, each of them is such a condenser.

Q. Now if you will finally turn to Arnold Patent No. 1,520,994, which has been characterized as the Gain Control Patent, the instrumentality which has been selected by the patentee to illustrate the invention asserted by the claims of this patent in suit and defining those claims as an impedance connected in shunt to the source of current is the resistance 25; is that right? A. It is.

Q. And the feature of adjustability of that impedance which is referred to in the claims of the patent in suit is illustrated by the arrow point 26 which is schematically illustrated as adjustable; is that right? A. I think not. Not if you meant literally what you said. The impedance *per se* is not adjustable. What is adjustable is the portion of the voltage drop across it which is taken to the grid.

Q. And that adjustability is obtained by means of the arrow point 26? A. That is correct.

Q. In one of these claims in suit the impedance thus connected is referred to as a potentiometer. That is merely a technical name for the arrangement shown by the resistance 25 and the tap connection 26, is it not? A. Yes.

622 *Frank M. Waterman—For Plaintiffs—Recalled—Re-direct.*

Re-direct Examination by Mr. Ashton:

Q. Listening to Mr. Darby's cross-examination I notice particularly he was referring to particular elements of these circuits. I rather gathered that he was trying to give the impression that the resistance here and there was all there was to it. In your direct testimony you have described the other elements, have you not, that enter into the
623 combinations of these claims? A. Yes, certainly.

Q. And pointed out the modes of operation? And the effects which the elements of the circuits as a whole have upon the result to be obtained? A. No. Certainly those elements have got to be taken with the whole combination. In most cases I think Mr. Darby merely identified elements which were distinctive without intending to include the whole combination. I answered with the understanding that he meant they were in the whole combination.

The Witness: The Lowenstein patent, as I un-
624 derstand its disclosure, goes generally to the operation of a tube with a source of potential applied between the filament and the grid, to render the grid definitely ultranegative with respect to any part of the filament. On this ultranegative potential the signal is imposed. The claims recite the complete combinations that constitute the invention, as I understand them. The Mathes patent carries forward the same idea, but goes to particular ways of getting that negative bias that are convenient and have other advantages. So far as Claim 8 is concerned the technical description of that claim is illustrated in Figs. 1 and 2 and Mathes gets the same nega-

tive bias and for the same purpose, but he gets it by means of a current flowing through a resistance, which current in Figs. 1 and 2 is the heating current for the filament. And he points out that that is a convenient method, in that it does not require an extra battery, and it is a useful method in addition, because the bias which is then acquired is one which will vary with the filament current and where the batteries are arranged as he shows, also with the plate voltage. 626
Therefore offering compensation for disturbance that would occur if those voltages did not vary together. Also he points out that that compensation may not be exact, but it is in the right direction, and it can be made more exact by an appropriate determination of the particular character of that resistance. That is found at the bottom of column 2 of page 1 and at the bottom of column 1 of page 2.

Mr. Ashton: I offer as a physical exhibit, and for the purpose of showing what was 627
before the Court as to the Lowenstein patent in suit, on the merits, and as to the so-called vacuum tube license defense, the record in the Court of Appeals for the Second Circuit in the case of Western Electric *et al.*, vs. Wallerstein.

Mr. Darby: I object to its receipt in evidence. I have no objection in the world to the Court having it, or presenting it to the Court informally for that purpose. I want to correct an impression Mr. Ashton is laboring under, and I do not want your Honor to get a wrong impression from that

source. The Wallerstein case was entirely different from this case.

The Court: Why do you need it as a physical exhibit, Mr. Ashton?

Mr. Ashton: We want to know what was before the Court. In order properly to refer to what was before the Court in that case we should have the record identified as a physical exhibit. That is frequently done, your Honor, and in the Wallerstein
629 case the second exhibit which I was about to offer was handled exactly that way—namely, the record in the Bunnell case, which I was going to refer to next, in which the Lowenstein patent and also the Mathes patent Claim 8 here in suit were sustained.

The Court: Of course any practical difficulty in making up your record will be obviated.

Mr. Darby: If it is a physical exhibit?

The Court: Yes.

630 Mr. Darby: I do not think it is admissible, but I say to your Honor, I want you to have it anyway.

The Court: You want me to have it but you object to it being received in evidence. Objection overruled, with exception.

Mr. Darby: Of course we are not bound by any testimony in the case. Its use is limited to that purpose, I assume.

The Court: I did not mean to anticipate argument with respect to the weight of the evidence.

Mr. Ashton: I want it clear that it is offered only as to what was before the

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Court on the merits of the Lowenstein patent, and on the so-called vacuum tube license defense.

(Marked Plaintiffs' Exhibit No. 27.)

Mr. Ashton: I also offer in evidence the record in the case of Radio Corporation of America, *et al.*, vs. J. H. Munnell & Company, *et al.*, in the Southern District of New York, which involved the Lowenstein patent herein suit and also Claim 8 of the Mathes patent, for the purpose of showing what was before the Court in that case.

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The Court: That is Judge Winslow's case?

Mr Ashton: Yes.

Mr. Darby: To be consistent, I make exactly the same objection; but I add to it a practical objection now. That case never went to the Court of Appeals, and I have not any means whatever, while it is pure in typewritten form—

Mr. Ashton: Let me state this record was handled in exactly the same way as the Lowenstein case, and we loaned it freely to Mr. Davis's office, back and forth, and you would be at liberty to do the same thing at any time.

633

The Court: To be consistent I will make the same ruling.

(Marked Plaintiffs' Exhibit No. 28.)

Mr. Ashton: That closes the plaintiffs' *prima facie* case.

DEFENDANT'S PROOFS.

Mr. Darby: To establish the chain of title and the authority for the American Transformer Company to manufacture the equipment that it made and sold to us under the patents in suit, as we contend, it is necessary for me to go to Governmental documents. The only form in which I have them is in the report of the Federal Trade Commission on the radio industry, which contained these documents, and I do not want to encumber the record with the entire report of the radio industry, so I would like to offer in evidence the particular agreements that I desire to utilize, with leave to substitute those agreements after I can have them copied. I know that the plaintiffs have many copies of them and maybe they will be kind enough to let me have copies of them.

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Mr. Ashton: Can't you tell me what agreements they are and offer them later?

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Mr. Darby: Surely. I tell you now it is the license agreement of the General Electric Company and the Radio Corporation of America dated the 20th day of November, 1919. That is the first one. The second one is the agreement of the General Electric Company and American Telephone & Telegraph Company dated July 1, 1920. The third one is called the extension agreement, General Electric Company, American Telephone and Telegraph Company, Radio Corporation of America and Western Electric Company. Just those

637

three. It shows the arrangement between the General Electric Company and the Radio Corporation of America and then between the General Electric Company, A. T. & T., and then between all of them and the Radio Corporation of America.

Mr. Ashton: Will you please repeat the purpose of the offer?

Mr. Darby: I want to prove the chain of license under the patents in suit to the American Transformer Company, of the 638 apparatus they sold to us.

Mr. Ashton: And that is the only purpose?

Mr. Darby: Yes.

Mr. Ashton: No objection.

Mr. Darby: Mr. Ashton has referred to another agreement and I would be glad to offer it. I picked out the only ones I thought were applicable. It is entirely agreeable, I understand, to Mr. Ashton, that we furnish clean copies of these various agreements. 639

The Court: We will reserve the first four letters of the alphabet for these exhibits.

(Same to be marked Defendant's Exhbits A, B, C and D.)

Mr. Darby: I offer in evidence a conformed copy of the license agreement between Radio Corporation of America, General Electric Company and Westinghouse Electric & Manufacturing Company and American Telephone and Telegraph Company, to American Transformer Company, dated February 1, 1927.

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Mr. Ashton: No objection.

(Marked Defendant's Exhibit E.)

Mr. Darby: I understand that the plaintiff is agreeable to stipulate that although that license agreement did not specify any patent by number, that all of the patents in suit were included in the license agreement.

Mr. Ashton: That is, the Radio Corporation had acquired rights under all of the
641 patents in suit which it could grant for the specific purpose and for the specific limited field covered by the license.

Mr. Darby: You do not dispute that each of the patents in suit were thereby included in that agreement, within that specific field, for that specific purpose?

Mr. Ashton: As were other patents.

Mr. Darby: Yes. It is also stipulated that the vacuum tubes employed by the defendant were purchased from radio dealers, that is dealers in radio equipment,
642 and were vacuum tubes manufactured by the Radio Corporation of America.

The Court: Were they manufactured pursuant to the provisions of Exhibit E?

Mr. Darby: No sir; they were manufactured under a vacuum tube license. If the Court please, on the patent side of this case Mr. Berliner, who is going to handle the other side of it, prefers that I go ahead with the patent side of it, and I am very much averse to using expert witnesses where the Court has been familarized with the subject matter, as in this case. I think Mr. Waterman has done a splendid piece

of work in familiarizing the Court with the particular subject matter of this case. I have an expert prepared to testify if the Court feels that it will be helpful. All I intend to do in connection with the prior patents that are relied upon is to offer them in evidence and point out to your Honor—I will do it personally if your Honor is of the belief that an expert will not be necessary—point out in a very few words in connection with each patent just 644
what part is being relied upon, and then we can say in briefs or oral argument everything that could be said by testimony. It is a mere matter of understanding that this is a condenser, that that is an inductance, and that that is the circuit in which it is connected. I have an expert who is prepared, if your Honor believes that is necessary, but I think I can cover the whole thing in half an hour on the patent side of the case.

The Court: Such suggestions of infor- 645
mation as I have been able to gather from time to time should be amplified in this case, Mr. Darby. But that is not as important as the question of your record. If you are seriously going into the question of invention any conclusion that is reached should be supported by testimony and not by argument.

Mr. Darby: The determination rests entirely upon a comparison of the circuit, and the only doubt in my mind is whether or not with what your Honor has already grasped in connection with this litigation

you feel able to make that comparison when the particular instrumentality is pointed out to you. I might illustrate what I mean by this. I went over in cross-examination of Mr. Waterman just what instrumentality is selected by the patentee to illustrate his invention. If I show that identical instrumentality and identical arrangement in the prior art that is all that is necessary.

647 The Court: But it seems to me you must show it was the result of testimony and not the result of argument, in order to have a finding which would hold water.

Mr. Darby: All an expert can do is merely point out what the drawing shows and if the drawing does not show it all the expert testimony in the world will not help it, and if it does show it all the testimony in the world will not support it.

The Court: I feel that is the safer way for you to present your case, however.

648 Mr. Darby: I offer in evidence a folder containing 32 patents of the prior art, which I have arranged for the convenience of the Court with suitable indexes, and for the convenience of the Court I have included in there an extra copy of each of the patents in suit.

Mr. Ashton: There may be some objection, until Mr. Darby tells me exactly what patents he is relying upon in connection with the list which he supplied me on February 5th. There were in that list supplied at that time six patents which had not previously been called to our attention

under the requirement of the Statute, of giving thirty days notice. As to any such patents or any additional ones that Mr. Darby may have included in his offer, I would object unless they are offered only for the purpose of showing the state of the art as distinguished from anticipations.

The Court: Do you claim anticipation with reference to any?

Mr. Darby: Yes. Which are the six patents, Mr. Ashton? 650

Mr. Ashton: The six patents are Langmuir 1,313,094—

Mr. Darby: Which is being used to show the state of the art. What is the next one?

Mr. Ashton: Kendall 1,330,471.

Mr. Darby: My impression is that that patent is pleaded. Subject to checking it up—

Mr. Ashton: No, that is not.

Mr. Darby: If it has not been pleaded it will be used for the art.

Mr. Ashton: In my statement as to 651 pleading I mean pleaded as to the particular patent in the bill of particulars which the defendant was required to file.

Mr. Darby: If it was pleaded in the particulars it is available for all purposes.

Mr. Ashton: Not unless it was pleaded as to the particular patent.

Mr. Darby: I question that.

The Court: Let us find out if it is mentioned in the bill of particulars.

Mr. Darby: I do not think it is mentioned at all.

Mr. Ashton: I do not know as to what patent you are citing it.

Mr. Darby: I might explain to your Honor that when we moved to segregate the issue of law from the patent, up to that time no search had been made of the prior art, therefore Judge Coleman allowed us I think something like thirty or sixty days to have that search made. With eight patents in suit that was a colossal
653 task.

Mr. Ashton: It was three years before that.

Mr. Darby: I know, but you had five years to bring this suit to trial and did nothing about it.

Mr. Ashton: It is not in any bills of particulars.

Mr. Darby: You are sure about that?

Mr. Ashton: Yes.

Mr. Darby: Subject to that check we will use that one to show the state of the
654 art.

Mr. Ashton: The next is Weagant 1,348,-108.

Mr. Darby: All right, state of the art.

Mr. Ashton: The next is Johnson No. 1,432,863.

Mr. Darby: State of the art.

Mr. Ashton: The next is Arnold No. 1,504,537.

The Court: Just a minute, I do not see that in this list.

Mr. Darby: It is patent marked K, your Honor, in the index, and your Honor will notice that that is down at the bottom of

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the index and I will explain its purpose right now. Four of the patents in suit are divisions of the parent application and that particular patent was held invalid by the Court of Appeals, in the Wallerstein suit, and I wanted to have before the Court the original patent which was held invalid in the Wallerstein suit.

The Court: Very well, we have that straightened out. I understood Mr. Ashton to say six patents and I have only four. 656
This Arnold patent makes five.

Mr. Darby: As to the state of the art.

Mr. Ashton: That is right. I am sorry, your Honor, I overlooked one. Patent No. 1,398,665, to Arnold. That also is not pleaded.

Mr. Darby: State of the art.

Mr. Ashton: I should add as those patents in this group, as to which their filing dates merely were earlier than the application of the patent in suit, to which they are cited, that objection is made to their 657
receipt in evidence, excepting on the ground that they are for prior invention. I think your Honor understands that an application filed earlier can only be used as evidence of prior invention, not as showing the state of the art.

The Court: You are now arguing again on the weight of the evidence, are you not?

Mr. Ashton: No, I am objecting to those particular patents that were not cited in the answer.

The Court: But you are not specifying

anything. That is too broad and comprehensive an objection.

Mr. Ashton: I will name those patents. Langmuir Patent No. 1,313,094, is based upon the application filed October 29, 1913.

The Weagant Patent 1,384,108, which is based upon the application filed April 9, 1914.

Mr. Darby: Just for your Honor's notation, perhaps I should draw your at-
659 tention to a decision by Judge Campbell in the Yale Hook and Eye case, 33 Fed. 2nd 295, which establishes the pertinency of these patents and utility of them, as showing the state of the art.

Mr. Ashton: It is a question of law, your Honor. I might suggest as to that, that the Court might like to reserve ruling, because it depends upon a question of law, which would have to be argued.

The Court: Do you press the objection?

Mr. Ashton: Yes, I press the objection,
660 your Honor, because it is very clear, as I understand the authorities, where an application has been filed, it can be offered only as showing prior invention.

The Court: Decision reserved.

RAYMOND T. CLOUD, called as a witness on behalf of the defendant, having been duly sworn, testified as follows:

Direct Examination by Mr. Darby:

Q. Mr. Cloud, please state your experience in the field of thermionic amplifiers; state your pre-

liminary education and whatnot which qualifies you to testify as an expert in this art. A. I graduated from high school and attended the University of Texas.

Q. In what course? A. In the electrical engineering course. I was unable to complete the course, due to financial trouble in the family, and I left the school and entered the electrical engineering work, which I have since been engaged in.

Q. When did you enter the electrical engineering work? A. In 1902. 662

Q. How long have you been familiar with thermionic amplifiers? A. Since 1912.

Q. Has your work been continuously connected with vacuum tube amplifiers since that time? A. My professional work has not been continuous, it has been in intervals, during that time, but it has been continuously since 1928.

Q. And in any particular branch of the industry? A. No, mostly relating to talking picture work and general amplification.

Q. Have you made inventions in the vacuum tube amplifier field? A. Yes, sir. 663

Q. On which you obtained patents? A. Yes.

Q. Approximately how many? A. I have made three inventions in the vacuum field and about eight in electrical allied fields, all of them relating to sound amplification.

Q. Since 1928, has your time been devoted practically exclusively to talking motion picture work and the electrical phases of it? A. Yes.

Mr. Darby: In the hope that it might be of benefit to your Honor, as well as to opposing counsel, may I, in taking up all of

these patents, read into the record the particular patents which are going to be referred to with respect to the particular patent in suit. I know that Mr. Ashton will appreciate that, because he has asked me for it.

The Court: All right.

Mr. Darby: Referring to Lowenstein Patent 1,231,764, the following patents in the prior art will be referred to:

665 De Forest No. 841,387, which is tab No. 1 in your Honor's book.

De Forest No. 879,532, which is tab No. 2.

Stone & Cabot No. 884,110, which is tab No. 3.

De Forest No. 995,126, tab No. 4.

Von Lieben & Reisz 1,038,910, which is tab No. 6.

Q. Will you please refer to the De Forest No. 841,387, and particularly Fig. 2 thereof. Refer

666 to the vacuum tube *a* of filament E heated by the battery B^1, which is the control electrode corresponding to the grid of the grid type audion. A. D^1 is the controlling electrode.

Q. What is the element marked B^{11}? A. That shows a battery in the control circuit.

Q. That is in the circuit connection between the grid and the filament? A. Yes.

Mr. Darby: I might interpolate to state, your Honor, that this is one of the two original De Forest patents, that was sustained in this Circuit and practically throughout the United States wherever it

became involved with the audion as an amplifier.

Q. And what is the device marked R in the output circuit of that structure? A. That is the receiver, or any receiving device in connection with the output of the tube.

Q. Is the battery B, the output circuit, source of supply? A. Yes, that is the source of the space current for the vacuum tube.

Q. And in all vacuum tube arrangements with which this case is involved, there must be employed some space current in the plate circuit of each tube, is that right? A. Yes. 668

Q. In this arrangement, with the De Forest devise, referring to Fig. 2, is the vacuum tube *a* used as an amplifier or as a detector? A. It is used in both relations, principally as a detector; a detector tube always amplifies.

Q. I think you perhaps made a mistake in connection with that and I call your attention to page 2 of the patent, line 31, which says:

"In Fig. 2 I have shown the line F as constituting the local circuit of a wireless telegraph receiving system including the battery B^{11} and oscillation detector T^{11}, the latter being connected in series with the antenna V and the earth E^{1}." 669

With that in mind, can you state— A. With that in mind, it is the amplifier.

Q. Is it an amplifier of low frequency currents or high frequency currents? A. Low frequency currents.

Q. That is audible frequency currents? A. Yes.

670 Q. What is the character of the frequency currents that are handled by the defendant's apparatus in this case? A. Audio frequency currents.

Q. In other words, low frequency currents, is that right? A. Yes.

Q. Will you turn to De Forest Patent 879,532, tab No. 2.

671 Mr. Darby: I might also tell your Honor that this is the patent—the original patent of the grid audion patent which has been sustained throughout the United States.

Q. (Continuing.) Is the vacuum tube D shown in Fig. 2 of the same type that was employed as the amplifier, as illustrated in Fig. 2 of the De Forest Patent 841,387, which we last considered? A. Yes.

Q. And which is the control electrode? A. The control electrode in this case is A^1.

672 Q. In this instance, is the tube D in Fig. 2 acting as both a detector and an amplifier? A. Yes.

Q. In what respect does the circuit arrangement of Fig. 1 differ from that of Fig. 2? A. Mostly with regard to the tubes themselves, the construction of the tubes.

Q. That is the grid electrode A of Fig. 1 has been substituted for the plate A^1 of Fig. 2, is that correct? A. Yes, the control electrode in Fig. 1 has a grid interposed between the filament and the anode, whereas in Fig. 2 it is an auxiliary plate.

Q. Now, will you please refer to Stone &

Cabot Patent 884,110, which is tab No. 3, your Honor; what is the stated object of the invention of this patent? A. The object of the patent is to provide a detecting device, and the object is to improve the sensitiveness of the oscillation detector.

Q. And this vacuum tube detector is also inherently an amplifier? A. Yes.

Q. And it is that factor that made it a successful detector? A. Detection is amplification in which one-half of the wave is amplified more 674
than the other in the case of the vacuum tube detector.

Q. Which is the controlling electrode in the audion structure shown by Stone & Cabot? A. G'.

Q. And what constitutes the input circuit? Trace it, please. A. The input circuit, starting with the filament is constituted by a secondary of an oscillation transformer I2 shunted with condenser C and from thence to the negative side of an auxiliary battery from the positive side to the grid and the voltage is created be- 675
tween the filament and the grid for control of the electron flow.

Q. In what respect, if any, does this disagree from the asserted invention of the Lowenstein patent? A. Only in the polarity of the battery.

Q. That is, in Lowenstein, he impresses a negative potential on the grid electrode, whereas Stone & Cabot impress a positive potential, is that right? A. Yes.

Q. Now, will you please refer to De Forest Patent No. 995,126 (tab No. 4, your Honor), refer to Fig. 2 of that patent. I notice that the polarity of the battery marked B for lighting

filaments, is indicated by the minus and positive signs, and that is true in connection with each instance where the grid type of audion is shown, so that the negative side of the battery is the side which is always connected to the grid electrode; do you check with me on that? A. Yes.

Q. What effect has the connection of the negative side of the filament battery on the polarity of the grid? A. The negative side of the battery, when connected to the grid, makes the grid nega-
677 tive relative to the filament, especially in the case of filaments that are not uni-potential. That is, there is a steady drop of potential across the filament and the current traverses it. So the grid on the side it is tied in is at zero potential, whereas as to the most positive side of the filament, it is negative with regard to the total drop of the filament. In other words, if the total current drop of the filament was 5 volts, the grid would be at the negative end, would be at zero potential, at the positive it would be 6 volts, negative to the filament, making an average of
678 one-half or two and a half volts negative.

Q. Now, if you will turn back for a moment to the De Forest Grid Audion Patent (tab No. 2) 879,532, is the filament lighting battery A there likewise connected with its negative terminal to the grid electrode? A. It is.

Q. This is the control electrode? A. Yes.

Q. Is that likewise true with respect to Fig. 2? A. Yes.

Q. Will you turn back once more to the original De Forest Vacuum Tube Amplifier Patent Fig. 2, and I call your attention to the fact that the control electrode as you have previously testified is the right-hand electrode D^1, and has the

polarity of the A battery B1 been arranged so that its negative terminal is connected with the control electrode? A. It is.

Q. Will you now please refer to the Von Lieben & Reisz Patent (tab No. 6) No. 1,038,910, and will you please call to the Court's attention what this patentee has to say with respect to the matter of potential on the grid, particularly the matter beginning at page 1, line 25 and extending to line 51? A. He says:

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"The subject of the present invention is further development of the above-mentioned invention wherein instead of being altered indirectly by means of an ionizer, the resistance on the main circuit is altered directly by means of the auxiliary electrode, on which the currents to be reinforced act. For this purpose the auxiliary electrode, which is likewise made of grid or net form, is arranged in such a manner that it completely intersects or divides the space between the cathode and 681 anode in the discharge tube; moreover, it is connected with the source of direct current in such a manner that it is an exactly defined potential corresponding to the degree of reinforcement required for the time being.

"In order to enable this potential to be adjusted as required, an adjustable resistance is preferably introduced between the electrode and the source of electric current. By this means the valve-like action of the incandescent electrode is dispensed with, since the alternating current to be

reinforced is superposed on the constant direct current whereby an undulatory current is formed from the alternating current."

Q. Now, will you please point out in Figs. 2 and 2-A of this patent how that effect is obtained? A. In Fig. 2, he attains it by a fall of potential across his cathode filament potentiometer arrangement C, he can thus create the po-
683 tentials relative to the auxiliary electrode,—

Q. Which is auxiliary electrode, H? A. H is the auxiliary electrode.

Q. This is the controlling electrode? A. That is the electrode.

Q. Corresponding to the grid of the vacuum tube? A. Yes.

Q. All right. A. And the microphone M through a transformer primary on which is marked P and S representing the secondary source of current for the microphone being H superposed upon this direct current created be-
684 tween H and the cathode K, the variable currents amplified by the circuit composed of anode A, output transformer S^1 and P^1, and sources of current not shown, merely marked "Positive" and Q to the negative side of the filament.

In Fig. 2-A he shows a polarizing battery B^1 as the source of his auxiliary current. This circuit is between—he has two cathodes in this tube, K and K^1; K^1 being the working cathode interposed in the auxiliary circuit. B^1 is the polarizing battery, similar to that of Stone, and before that of De Forest, and the manner of operation is similar to Fig. 2, inasmuch as the current of the microphone is superimposed upon the control

grid circuit to control current in the output of the anode of the tube.

Q. With the battery connected as there shown with the positive terminal, and I am referring to battery B^1, with the positive terminal towards the grid electrode, would the grid electrode be more positive or more negative with respect to the cathode K^1? A. It would be more positive.

Q. Now take up consideration of Mathes patent No. 1,426,754. As against that patent we will use Arnold Patent No. 1,129,942, Tab. No. 686
10; Arnold Patent 1,129,943, Tab. No. 11; Reisz Patent No. 1,234,489, Tab No. 16; Colpitts and Arnold Patent No. 1,388,450, Tab No. 27. Will you please refer to Arnold Patent No. 1,129,942, Tab No. 10. A. We have a diagram in connection with that (handing counsel).

Q. Will you please refer to Fig. 5 of that patent. A. Yes.

Q. How are the audion tubes numbered 1 and 2 connected, in series or in parallel? A. In series.

Q. Are the filament electrodes heated from separate, independent sources, or are they heated 687
from a common source? A. The filament electrodes are heated by a common source, battery No. 12.

Q. Are the grid electrodes 3 and 7 of the middle and last tube provided with means for maintaining them negative with respect to the filament? A. They are.

Q. What are the means? A. The means for providing them negative are the C battery 11, resistance 14 and the resistance of the filament of the first tube 5.

Q. Is the filament of a vacuum tube similar in principle and operation to the filament of an

incandescent lamp? A. Yes, it is very similar; they have similar characteristics.

Q. And when the vacuum tube is lighted is the filament heated to incandescence? A. Yes.

Q. And what makes it visible to the eye, is it the resistance of the filament which causes it to become heated? A. Well, it is the effect of the resistance. It is the power dissipated through resistance.

Q. So an ordinary incandescent light filament
689 or an audion tube filament is a resistance element? A. Yes.

Q. If the battery 11 were removed from the circuit, what would be the potential on the grid electrodes of the tubes 1 and 2? A. We will take 2 first. If the battery 11 were removed, the potential on the grid would be the potential of battery 13 in a positive direction minus the drop of potential across the resistance of filament 5 of the first tube minus the drop of the space current of the first tube through resistance 14.

690 The Court. Minus what?

The Witness: Minus the potential drop across resistance 14 of the space current for the tube No. 1.

Q. Have you prepared a simplified drawing showing the circuit insofar as it is pertinent to the present case, of Fig. 5 of this Arnold patent? A. I have.

Q. Will you please produce it? A. Yes (handing counsel).

Q. Have you checked this simplified drawing, and can you vouch for its accuracy in simplified form? A. I can.

Mr. Darby: I offer it in evidence.
(Marked Defendant's Exhibit G.)

Q. Will you please briefly describe the arrangement there shown? A. This is the drawing of Fig. 5 of Arnold Patent 1,129,942, in which I have substituted the resistance of the filament of the first tube as shown by R1 in the drawing. The filament battery reverses resistance R2, which is representative of the tubes No. 3 of the patent drawing as well as, I believe there 692
is a resistance 14—yes. Through the filament of the second tube, through resistance R1 which is that of the filament of tube No. 1, thence to the negative pole of the battery. A potential drop of voltage is created across resistance R1. This R1 is also included in the grid circuit of the input to tube No. 2, represented grid No. 1, including the B battery E9, resistance R8 and C battery E6. The resultant negative potential impressed upon the grid would be E9 minus E6 minus all of the sum of E6 plus R8Ip plus R1 If.

Q. What is the significance given in the pat- 693
ent for the spacing of the plate electrode relative to the filament electrode as diagrammatically illustrated on Sheet 2 of the drawings, and more specifically illustrated in Sheet 1 of the drawings? A. You are referring back to the patent now?

Q. Yes. A. The patent itself?

Q. Yes; has that to do with controlling the internal impedance of the tube? A. Yes, the spacing of the plate relative to the filament has to do with the internal impedance of the tube as well as the other factors.

Q. Now will you please refer to Arnold pat-

ent No. 1,129,943, Tab No. 11. Are the tubes there illustrated likewise cascaded or series amplifiers? A. They are.

Q. From what source are the respective filaments heated? A. In Fig. 1 they are heated by separate batteries numbered 7 in each case; Fig. 2 they are heated also by a common battery source, No. 7.

Q. Is the grid electrode of each of the tubes biased? A. They are.

695 Q. How? A. They are biased by means of biasing battery 6, the drop of potential across the resistance 8 and the B battery 9, and also, in the case of all except the first tube, by the filaments of all of the preceding tubes.

Q. I notice that Battery 12 apparently impresses a bias on the grid of the next to the last tube of a positive character, as well as the grid of the last tube; is that correct? A. That will depend upon the preceding biases.

Q. In other words, if the preceding biases—A. If the preceding biases, including [redacted] fila-

696 ments and drops across the resistance, if they were too highly biased by battery 6, then 12 may only reduce the amount of negative bias on the tubes.

Q. I notice that each of the grid electrodes of the tubes other than the first tube is connected through a circuit which leads to the negative side of the battery 7; is that correct? A. That is correct.

Q. If the biasing batteries 6 and 12 were eliminated, taken out of the circuit entirely, what would be the potential of the grid of all of the tubes except the first tube relative to the filaments of each tube? A. The potential of the grid

would be the potential of B battery 9 minus the drops of potential across resistances 8, minus the drop of potential through the filaments of the preceding tubes. By preceding meaning from the negative end of the A battery.

Q. And would you not likewise have to subtract the potential of the battery 7? A. Well, you would only have to subtract the potential of battery 7 to the extent of the potential that was expended in the resistance of the tubes to the left of each one of the tubes you are consider- 698
ing.

Q. Now will you refer to Reisz Patent 1,234,-489, Tab No. 16? A. Yes.

Q. In this arrangement the filament derives its heating current from battery B, does it not? A. It does.

Q. And connected across the battery B is a potentiometer or resistance W1, is that right? A. Yes.

Q. From which is tapped an adjustable connection to the grid electrode 8, is that right? A. Yes, that is right. 699

Q. Now, what is the potential of the electrode H relative to the potential of the filament K? A. The potential of H is at some intermediate point relative to the potential K depending upon where the connection is made to the resistance, this potential being derived by the fall of potential through the resistance W1.

Q. Now as I understand you, you made reference earlier in your testimony to this, let us consider the filament K for a minute; it consists of one leg that runs through the tube upwardly into the shape of a W and then down through the bottom of the tube? A. That is right.

Q. What is the potential of the filament at the W part, relative to the left or entering leg? A. At the W part of it relative to the left entering leg it would be positive to the entering leg at the left.

Q. And what would be the potential of the right leg relative to the left entering leg? A. The potential of the right leg would be positive relative to the entering leg.

Q. What would be the potential of the W rel-
701 ative to the right leg of the filament? A. It would be negative to the right leg of the filament.

Q. Therefore, if the grid electrode tap connection made to W^1 was moved entirely to the left of the potential W^1, what would be the potential of the grid electrode H relative to the filament? A. It would be an average negative potential of one-half the negative potential.

Q. If the tap connection was moved entirely to the right end of the potentiometer W, am I correct or not in understanding that the potential of the grid H would then be positive with respect
702 to the average one-half of the filament potential? A. It would.

Q. Now, will you please turn to Colpitts and Arnold Patent No. 1,388,450 (which is tab No. 27, your Honor), referring to Fig. 2 and the right-hand corner thereof, there are two vacuum tubes, the audion tubes 27 and 28 there shown; are they used as amplifiers? A. They are.

Q. Will you briefly describe the arrangement there shown for heating the filament, having particular reference to page 2, line 122 and page 3, line 2, inclusive and state what the polarity of the grid electrode is relative to the filament and how that polarity is obtained?

"Where an alternating current source is employed for this purpose, the filament circuit should be shunted by an inductance 62, the middle point 63 of which is connected to the output circuit through a resistance 64. Each half of the inductance 62 is shunted by a condenser 65."

Here we have the filament heated by an alternating current generator No. 61 and the two filaments are in what is called parallel connection, 704
as differentiated from the series connection that I discussed before.

Q. That is with the Arnold patent? A. That is with the Arnold patent. I believe that the reason for resistance No. 62 and for connecting in the center tap was explained thoroughly by Mr. Waterman when he was on the stand and discussed similar matters, and I won't attempt to go over it again unless you have some questions in connection with it.

Resistance 64 is connected from the center tap, resistance 62 is the return circuit for the two 705
tubes 27 and 28. I trace that circuit from generator 66 which supplies the space current, the positive side goes through the primary of the output transformer 38, divides and goes through the two tubes 27 and 28, flows from the plate on each of these tubes to the filament, thence reunited at the junction point just above 62—they reunite at the junction point of 62 and traverse resistance No. 64.

The direction of the current is such that the top end of 64 is the positive and the lower end is negative. This resistance is also included in the grid input circuit starting from the bottom

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of 6 through the resistance condenser and transformer combination No. 60, 59 and 58 to the grids of the respective tubes Nos. 27 and 28. The drop of potential thus creates a negative bias upon the tubes 27 and 28, equivalent to the voltage expended in resistance No. 64.

Q. And is the negative bias that is effected on the grid in defendant's apparatus similarly effected by means of the drop of potential across resistance included in the current supply cir-
707 cuit? A. It is.

Q. Now, we will take up consideration of the Arnold patents. Take up first Arnold Patent 1,329,283, the Power Circuit Patent in connection with which, we will consider Seibt Patent 1,012,456, tabbed No. 5; Arnold Patent No. 1,129,943, tabbed No. 11; Colpitts Patent No. 1,129,959 tabbed No. 12; Langmuir Patent No. 1,558,436, tabbed 32.

Referring first to the Seibt patent, tabbed No. 5, in what particular art is this classified? A. It relates to radio telephony and does not in-
708 volve the vacuum tube.

Q. Will you call the Court's attention to the matter beginning at line 38 on the first page?

> "According to the present invention the variable resistance is brought into such relation to the fixed resistance that the variation of pressure produced by the acoustic vibration cause a maximum variation of radiated electrical energy."

And then he goes on to work out through a set of mathematical formulas that I don't think is necessary to attempt to follow.

Q. Before you go into the mathematical formulas, let me read this statement to you:

> "In the case in which the oscillations are produced in the antenna itself or transferred to it by loose coupling from a closed oscillation circuit and assuming the microphone to be inserted directly into the oscillation circuit, theory shows that resistance of the microphone ought to be numerically equal to the other resistances of the antenna or in other words, that the damping produced by the micro-antenna itself." 710

In this radio telephone system, is there an input circuit and output circuit? A. There is.

Q. What comprises the input circuit? A. The microphone itself is an input circuit.

Q. What is the output circuit? A. The output circuit is the antenna.

Q. Referring now to page 2, line 3, after the mathematical discussion you referred to, appears the statement: 711

> "Hence the condition for maximum efficiency is that the resistance of the microphone and of the system to which it is connected should be equal."

What is the significance of that statement? A. The significance is that it seems to be a universal law, wherever energy is taken from a generator of any kind whatever, that the condition for maximum efficiency shall be when the exterior resistance is equal to the internal impedance of the device.

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Q. Now, will you refer to Arnold Patent 1,129,943, tab No. 11. This patent you previously considered with reference to the Mathes patent, and will you briefly review the subject matter contained in lines 11 to 34 of the patent? A. I will read the lines first:

> "This invention relates to the use of thermionic repeaters, such as the audion, as amplifiers without transformers, and
713 more particularly to the use of thermionic repeaters for securing amplifications of current in circuits of low impedance.
>
> "In many instances it is necessary or desirable, for securing the best results, to exclude transformers from the circuit. Such is the case, for example in those circuits in which the frequency is so low that efficient transformers are costly and difficult to design, as is the case in telegraph circuits in general and especially in submarine and wireless telegraph circuits. It
714 is particularly desirable to exclude transformers from circuits in which an exact reproduction of wave form is necessary for legibility, as for example in submarine cable circuits. It is also desirable to exclude transformers from circuits in which undistorted amplification must be secured over a wide range of frequencies, as, for example, in the reproduction of speech and music."

In this case, he is trying to secure the most efficient results by building his tubes or arranging his tubes in such a manner as to meet this

universal law of getting the load somewhere of the same order as the output impedance of the device without the use of transformers, such transformers acting as a magnifier of currents.

Q. And does he connect audion amplifiers in series without the use of transformers? A. He does.

Q. Now, referring to lines 41 to 48, he states that:

> "The impedance of the input circuit of an efficiently operating audion of the usual type is very high, at least 100,000 ohms, and in general as high as 10 megohms." 716

As translated by Mr. Waterman, that would be equivalent to 10,000,000 ohms, is that right? A. Yes, that is right.

Q. Will you now explain the significance of the statement made, page 1, line 62 to line 93? A. (Reading):

> "It has been discovered that audions may be so constructed that without the use of transformers, they will step up the input voltage of either direct current or alternating current of any frequency in one step to as much as thirty times its original value, or in two successive steps to as much as 500 times its original value. The voltage amplification thus secured is entirely free from wave distortion whatever may be the initial frequency and wave form. It has been discovered that the output voltage of one of such audions or of a plurality thereof in tandem may be stepped down and the resultant current greatly amplified by having such audion 717

or plurality of audions work into a plurality of similar audions in multiple, with the output of each going to a common circuit. This common output will be an amplified current of relatively low voltage. It has been discovered that a combination of one or more such audions working into a sufficiently large number, for example from fifty to one hundred, of similar audions in multiple, with a common output, will operate, without transformers, from a line of low impedance, for example 250 ohms into a light line with a resultant current much greater, fifty or more times as great, than would flow in the second circuit if it were directly connected to the first circuit."

719

Mr. Darby: I call the Court's attention to the fact that in lines 95 to 101, reference is made to the fact that he had produced a specific type for doing this, identifying it by serial number filing date, and that is the audion shown in Patent No. 1,129,942, tab No. 10, with the spaced electrodes for the purpose of obtaining impedance effect. It is on the second sheet.

720

The Court: Yes.

Q. On page 2, line 8, will you please read what is there said with respect to the audion construction in so far as it affects the internal impedance of the tube? A. (Reading):

"The several audions may be of the usual construction, but to secure most efficient results the input electrode may be in the form of a grid 1, preferably

made of very fine wire with a fine mesh or the like, and the output electrode or plate 2 is placed at a considerable distance from the filament 3. The filament, grid and plate are as usual sealed in an evacuated bulb. In order to secure best results, the grid should be near the filament, the plate should be distant from the filament, and the grid should present a finely meshed or discontinuous surface between the filament and plate. This type 722 of audion is adapted to give an amplification with low current and high voltage in its output circuit."

Q. Do you consider those statements correct as to the bearing on the matter of the internal impedance of the tube? A. The grid has little bearing upon the internal impedance of the tube, that is as far as the geometrical structure is concerned.

Q. That is the impedance between filament and plate? A. Impedance between filament and plate. 723

Q. You agree with Mr. Waterman on that then? A. Yes.

Q. Beginning at line 42, the statement is made:

"The output circuit of each audion includes its output electrode or plate 2, a high resistance 8, a battery 9 and the filament of the audion. The resistance 8 should be, for example, 100,000 ohms or more."

Do you consider that to be a high resistance? A. Yes, I consider 100,000 ohms a high resistance in the plate circuit.

Q. From your knowledge of audion tube amplification, I call your attention to the statement beginning at page 2, line 73:

> "By combining two or more audions in tandem working into a number of audions in multiple, for example, from ten to one hundred, the combined system will operate without the use of transformers, from an incoming line of low
> 725 impedance with a resultant current of more than fifty times that which would flow in the outgoing line if the latter were directly connected to the incoming line."

You have no reason to question that? A. I have no reason to question that.

Q. Then at line 105, the statement is made:

> "The invention is also particularly adapted for use in circuits where especially pure or loud reproduction of speech
> 726 or music is desired."

What do you understand is meant by the term "pure" as there used, undistorted? A. Undistorted.

Q. What if anything does this patent teach you with respect to the matter of matched impedances? A. It teaches me that it is of primary importance where you want to get maximum efficiency out of the tube.

Q. That is, the output impedance should be matched by the internal impedance of the tube? A. Yes.

Q. Will you next turn to Colpitts Patent 1,129,959, tab No. 12.

Mr. Ashton: If you have no serious objection, I would like to point out to the Court that this Arnold patent to which we have been referring was filed on the same day as the application upon which the Arnold patent in suit, No. 1,329,283, the patent to which Mr. Darby has been referring, was granted.

Mr. Darby: Wait a minute. Which patent was I referring to?

Mr. Ashton: The patent in suit goes 728
back to the same date as the date in the Arnold patent.

Mr. Darby: One of us is mistaken, Mr. Ashton. One of us is very much mistaken. The Arnold patent in suit was applied for July 30, 1918.

Mr. Ashton: It is a continuation of part of the original application 841,567 filed May 28, 1914.

Mr. Darby: That is not what you said. It is a continuation, but the legal status of a continuing application is something 729
that this Court is going to pass on. The application which matured in the patent in suit was filed July 30, 1918.

Q. Will you now turn to the Colpitts Patent. I think I have given you the data on that. Before referring to the drawings, I call your attention to this statement appearing on page 1, line 19:

"A well known law of electric circuits requires that the impedance of the external path in the circuit should be equal

to the impedance of the internal path or source, whenever the maximum of available energy is desired."

Is that a correct statement? A. That is correct.

Q. What do you understand to be the asserted invention of the Arnold patent No. 1,329,283 under consideration? A. I understand that the invention relates to matching the output impedance of the tube with an external impedance
731 of the same order.

The Court: Is there anything in the claims on this patent in suit?

Mr. Darby: The prior art patent?

The Court: Yes.

Mr. Darby: I call your attention to Claim 1. I have marked it, and I don't know whether this patent is being used for a defense to one of the other patents or not. I can tell your Honor in just a minute.

732 The Court: Claim 1 you called attention to?

Mr. Darby: Yes. No, I marked that claim 1 in connection with another comparison.

The Court: I do not find anything in the claim about it, do you, because this is merely a recital in the specifications, but I asked you if there was anything, and you said this was.

Mr. Darby: I do not think there is any. I have marked a claim, but I see is to call to your Honor's attention another patent in suit. Of course your Honor

understands that irrespective of what is claimed, it is what is disclosed that is material. Now I call your Honor's attention to this statement—

The Court: I also understand that that depends on which side of the case you are on.

Mr. Darby: Yes, sir; very much.

Q. I call your attention to this statement of various types of known amplification devices. Line 45, your Honor: 734

"Of the various types of known amplifying devices, those in the general class of vacuum discharge repeaters such as the ionized gas type and the type known as thermionic exemplified by the 'audion' have advantages with respect to amplifying very low frequency currents, since the output currents in such devices are not subject to severe distortion due to external or internal disturbances, but are substantially determined as to their form 735 by the form of the input current."

Can you very briefly describe what is meant by that statement? A. The statement refers to the fact that the tube of the audion type will amplify without distortion, in effect is what it means, that this grid does not draw any current from the source.

Q. I likewise call your attention to the statement beginning at page 1, line 101:

"The unbalanced condition and inefficient operation which would be met in the use without a transformer of any known

type of vacuum discharge repeater and the necessity of using the undesirable transformer to balance impedances are at once avoided in accordance with this invention by the use of two or more vacuum discharge repeaters having different impedance characteristics and working one into the other by direct connection. Two such vacuum discharge repeaters may be placed in seriatim between the cable and
737 receiver, the one connected with the cable having high output impedance and preferably also a comparatively low input impedance such as the ionized gas repeater, and the one or more connected with the receiver having high input impedance such as the audion, and preferably arranged to offer a comparatively low output impedance."

Now, referring to the drawing—

738 The Witness: Yes.

Q. Now, referring to the drawing, what is there illustrated as an ionized gas repeater? A. The device shown to the left of the figure 1 shows a form of ionized gas repeater.

Q. And the audion tubes numbered 6, 7, 8 and 9 are not the ionized gas repeaters that he refers to there, are they? A. No.

Q. These audion tubes are connected in series, are they not? A. The filaments are in series, but the plates and grids are in parallel.

Q. And are they used as amplifiers? A. They are used as amplifiers.

Q. Now at line 124 this statement is made:

> "The different parts of these circuits are or may be balanced electrically in the following manner: the electromagnet 4 of the gaseous repeater 3 may be wound to any impedance desired, thus making it of an impedance of the same order of magnitude as the cable from which it receives energy. By using a number of audions in the way shown in Fig. 1, the 740
> combined impedance of the output circuit may be made of the same order of magnitude as the receiver or siphon recorder. The output-input circuit between the gaseous repeater 3 and the audions is naturally well-balanced, inasmuch as the output circuit of the gaseous repeater and the input circuit of the audions are both of high impedance and approximately of the same order of magnitude."

What bearing has that statement on your testimony as to the teaching of this patent as to the advisability and necessity of matching the impedances? A. This features again the attempt to match up the impedance of the incoming line to the outgoing line so as to get the maximum efficiency of the repeater. 741

Q. Now, if you will refer to Langmuir patent 1,558,436, which is tab No. 32—

> Mr. Darby: I might tell the Court that this is the Langmuir patent for the so-called High Vacuum which was invalidated by the Supreme Court after a controversy

which started about 1915 and terminated the year before last in the Supreme Court, and in that decision, which your Honor will hear more of in the trial because of language that was employed, as particularly bearing on the radio industry and this particular art, one of the contentions made was that the geometry of tubes was an expression that was used throughout the trial and argued, and the geometry of
743 the tube was one of the elements of the invention and necessary to be met in order to create high vacuum. It was a peculiar situation where the present plaintiffs and I as counsel—not this same counsel, the plaintiffs and I were combined in the fight against the General Electric Company, although we are split asunder here, and the only purpose of referring to this patent at all is because of the reference that is therein made to "the geometrical proportions of the device also affect the
744 amount of current which will pass with a given voltage, but as these conditions remain fixed for a given device, they may be represented by a constant, an equation expressing the relation between the current and the voltage."

The Court: Have you, incidentally, a reference to that?

Mr. Darby: The Supreme Court decision?

The Court: Yes.

Mr. Ashton: It is reported in 283 U. S., 664, and the change in the opinion, which was made, as a result of the petition for

rehearing, in the last page of the opinion, is in page 284 U. S., at page 571.

Q. We will now take up consideration of Arnold patent No. 1,349,252, which has been characterized as the Straight Line Characteristic Patent. The art that will be relied on in connection with that patent consists of Arnold 1,114,845, tab No. 8; Pierce, No. 1,127,371, tab No. 9; Arnold, No. 1,129,943, tab No. 11; Colpitts, No. 1,137,384, tab No. 13; Langmuir, No. 1,223,496, tab No. 14; Kendall, No. 1,330,471, tab No. 20; DeForest, No. 1,375,447, tab No. 24; Weagant, No. 1,384,108, tab No. 26; Hewitt, No. 1,393,369, tab No. 28. 746

Mr. Darby: Your Honor will recall, before I refer to this art specifically, that this is a patent which is indicated by the insertion of an additional impedance in the plate circuit.

Q. Now, will you please refer to Arnold patent No. 1,114,845, tab No. 8. Is there any additional impedance added to the output circuit of the circuit there shown in this patent, Mr. Cloud? A. Yes, in Fig. 1 and Fig. 3 there is an additional resistance 8 and condenser 9. 747

Q. In Fig. 1? A. Fig. 1—No. 2, rather.

Q. Is there additional impedance of No. 3 consisting of the resistance 8 and the shunt coil of inductance 10? A. In that case the resistance is in shunt to the load.

Q. And if you will refer to Fig. 5 of the Arnold patent No. 1,349,252, the resistance R' is in shunt to the output circuit, is it not? A. Yes.

The Court: Would you mind having the witness define what he means by the term "in shunt"?

Q. Please state so. A. A resistance in shunt is the same as a resistance in parallel. It means that if, instead of being in series, as shown by Fig. 3, it would be shunted directly across the output terminals.

Q. That is, instead of being connected end to
749 end to it, it is connected around it, is that right? A. Yes.

Q. As a by-pass? A. So as to short circuit the device, in other words; the form of a by-pass.

Q. I call your attention to the statement contained in the Arnold patent—

The Court: That is what is indicated, is it, by R1?

Mr. Darby: Yes, sir; as Mr. Waterman testified, your Honor will remember, probably, in cross examination, that R1 is con-
750 nected in shunt through that transformer.

The Court: Yes.

Mr. Darby: In any one of these circuits this resistance is connected in series. If I want to connect it in series to this coil, for example, because it is connected end to end to it—if I wanted to connect it in shunt, I would connect it around this way (indicating), as a by-pass around here.

The Court: Yes.

Mr. Darby: That is what is referred to "in shunt."

The Court: Well, what was doubtful to me is this diagrammatic indication. That

looks like a separate unit. That is not connected, that portion, with anything.

Mr. Darby: Yes, sir.

The Witness: That is a transformer.

Mr. Darby: That is a transformer. That is the primary and secondary of a transformer, and if I can possibly clear your Honor's mind on the subject by referring to the next page of the patent you are considering, where it points out, "While the resistance has been shown as connected directly in the output circuit of Fig. 3," at the top of the page: 752

"While the resistance has been shown as connected directly in the output circuit of Fig. 3, it is to be understood that the invention is broader than this and that the resistance may be inserted in other ways. It may, for example, be carried into this output circuit by means of a transformer. That is, if as shown in Fig. 5 the resistance R1 is actually included in the secondary circuit of the output transformer, it will produce an effective resistance in the primary circuits yielding, to all intents and purposes, the same result as if a resistance had been actually placed in this primary circuit. The value of the effective resistance produced in said primary by a given resistance in the secondary circuit will, of course, depend on the ratio of transformation of the transformer." 753

And the whole theory of the operation of a transformer is that it passes from one circuit in which one coil of a transformer

is included, this electrical effect into the next circuit into which the other coil of the transformer is included. Is that cleared up, your Honor?

The Court: It helps.

The Witness: That is, it can magnify the resistance or make it smaller.

Mr. Darby: That is, it can be a step-up transformer, or a step-down transformer.

755 Q. With reference to the resistance I find this statement in the patent, beginning at line 31:

"It has been found experimentally that the establishment of the condition of discharge described above as the blue haze may be prevented by placing, in series with the battery, a balancing resistance of such high value that the increase in current which would normally take place when the condition in the bulb corresponding to the blue haze exists, results in such
756 an increase in fall of potential across the resistance as to render the maintenance of the condition corresponding to blue haze impossible."

Now, will you briefly explain that statement. A. This patent was directed towards the tube at the time that it was very difficult to get entirely free of the gases that were in the tubes, and occasionally they would get a sharp increase in voltage that would start ionization in which the electrons would come in contact with actual particles of gas, and in such cases they would create more electrons and this bombard-

ment and the current would very sharply rise, due to the fact that this ionization had taken place. The resistance was inserted in there for the purpose of limiting this sudden flow of current that took place when ionization takes place.

Q. Referring to the curves of the patent in suit which we are considering, take the curve of Fig. 4, for example, if a blue haze effect occurred, what effect would it have on the curve? Would it cause it to rise very sharply? A. Very sharply. 758

Q. And the purpose of putting this resistance in the plate circuit was to keep the curve straight or normal, whatever it may have been? A. Well, it is very difficult to say that a curve in a gaseous tube was straight, but it tended to keep—

Q. To keep it to a normal condition; is that right? A. Yes.

Mr. Darby: And in that connection I call your Honor's attention to the subject matter of the claim, the single claim here in the case. 759

Q. Does that patent teach that one cycle in the art, in your opinion, the utilization of a resistance in the output circuit of a tube to prevent deformation of the curve due to increased current on the input? A. It does.

Q. Now, will you please refer to Pierce patent No. 1,127,371, tab No. 9? I call your attention particularly to Fig. 2, in which a 3-electron audion type is shown, and ask you if any additional impedance or resistance is employed in the output circuit of that tube? A. Yes, resistance No. 39 is included in the tube.

Q. And what function will that resistance in the tube plate serve? A. Well, it will serve to straighten the characteristic of the tube in the manner stated.

Q. In other words, if any resistance is included in the plate circuit of a tube, will it not inevitably and unavoidably serve to straighten out the characteristic of the tube? A. Undoubtedly, from zero on up.

Q. And all depending upon the amount of re-
761 sistance that is put in? A. All depending upon the amount of resistance that is put in.

Q. I call your attention to Arnold patent No. 1,129,943, tab No. 11. Are any impedances or resistances included in the plate circuit or output circuit of any of those amplifier tubes? A. Resistances in Fig. 1, resistance 8 are included in the output of each of the tubes; in circuit 2, resistance 8 are included in the output of the tubes 1 and 2, and a single resistance 8 serves as an output for tubes 3, 4 and 5.

Q. I call your attention to the statement be-
762 ginning at line 42 of page 2:

> "The output circuit of each audion includes its output electrode or plate 2, a high resistance 8, a battery 9 and the filament of the audion. The resistance 8 should be, for example, 100,000 ohms or more."

What is the value of the resistance employed in the defendant's apparatus in that tube, where a high resistance is employed? A. They vary in the circuits as marked. In V1 it is 60,000 ohms; in V2 it is 6,880; in V3 it is 112,000 ohms; V4 and

V5, the two in series, it is 645,000 ohms, and in V6 and V7 it is 5,000 ohms.

Mr. Darby: And I call to the Court's attention that it is charged that defendant infringes this patent in all of the apparatus, A-41, A-36 and PA-39. All of that is charged to be an infringement.

Mr. Ashton: But not as to V2.

The Witness: Not as to V2.

Mr. Darby: But not as to V2 of A-41. 764

Q. Now, will you please turn to Colpitts patent No. 1,137,384, tab No. 13. Do you find any additional resistances or impedances included in the output circuit of any of the tubes shown in this patent? A. Yes, in Fig. 2 there is an additional resistance between the condenser 8 and terminal 5 of the transformer.

Q. And that is shown as an adjustable resistance, isn't it? A. Yes, an adjustable resistance.

Q. So that its value can be changed at will? A. Yes. 765

Q. Now, will you please refer to the Kendall patent 1,330,471, Item No. 20? I call your attention to Fig. 4 and the intermediate vacuum tube circuit, the one in the middle. Is there a resistance or— A. Yes, marked 80.

Q. That is connected in the output circuit of the tube? A. It is.

Q. In addition to its ordinary load? A. It is.

Q. The patent states this, to which I call your attention, page 1, line 15:

"In wireless signaling, the extraordinary weakness of the received signals

makes it highly desirable to use means for intensifying the effect produced on the translating device. In the case of wireless telegraphy, this is a comparatively simple matter, for the chief requirement is to obtain an indication, with small regard for the distortion produced. In the case of wireless telephony, however, where the high frequency carrier waves are modulated in accordance with
767 the speech signals to be sent, the problem is much more difficult, for the intelligibility of the translated signals depends on the faithful reproduction of the modulations of the carrier waves. This means that the distortion must be kept to a minimum."

Then on page 3, line 4:

"In this Fig. 4, there is a different arrangement of output circuit for the de-
768 tector. As shown in said figure, there is placed in series with the power battery 35 a high non-inductive resistance 80."

Then again at line 42:

"In practice, it is desirable that the transformer 82,83 shall be adapted to work between circuits of high impedance, and that the resistances 80 and 84 shall be large. With the thermionic detectors which I have commonly used; I find that the resistances 80 and 84 may be of the order of 100,000 ohms."

I next call your attention to De Forest patent No. 1,375,447, Item 24, and I might say in connection with this patent that although it does not appear on its face the plaintiffs in this action acquired rights under these De Forest patents, and this is the patent for the so-called Cascade or Seriatim amplification of audions. I might also say that this patent was secured after an interference proceeding in the Patent Office.

The Court: Who were parties to it? 770

Mr. Darby: Langmuir, of the General Electric Company, and Dr. De Forest. Dr. De Forest prevailed, establishing the application of the invention, in September, 1912. I think reference has been made either in opening by the plaintiffs or some one of the telephone engineers made the statement on the witness stand, that Dr. De Forest brought the audion to the Western Electric Company and Dr. Arnold took the audion and developed it, increased the vacuum of it, and these cir- 771
cuit experiments were going on at the same time, which gave rise to this series of patents, all of which was preparation work for establishing trans-continental telephony, and it was on the cascade audion amplifier shown in this patent that was exhibited to the engineers of the Western Electric Company by Dr. De Forest in October, 1912, and I do not believe it is necessary to give any expert testimony in connection with that. I want the patent before the Court because it shows the broad idea of cascade amplifica-

tion, and various means of coupling them, and I might merely call the witness's attention to Fig. 1, compared with Fig. 2. There appears to be 2 coils marked 16 in Fig. 2, and there is only one coil, marked 13, in Fig. 1. Now what is the difference electrically between that arrangement?

The Witness: In coil 16 the two windings were the same, or the ratio is 1 to 1,
773 there would be no difference in them, because it is a 1 to 1 transformer. However, with Fig. 2 we can change the ratio so as to get a voltage step-up between the stages of amplification.

Q. And in the art where there is a one-to-one transformation, that instrumentality or transformer is known as an auto-transformer, is it not? A. Yes.

Mr. Darby: Does your Honor understand that an auto-transformer has only
774 one coil there? It is merely cutting across

The Witness: You can have more than one-to-one, for instance here, you step down to have two windings act as one. I mean one acts as two.

Q. The one acts as two, that is what you mean? A. Yes.

Q. Referring to Fig. 5 of the patent, I notice in the output circuit of the last two tubes of the cascade amplifiers, that there are a number of loudspeaking devices, 91, 92, 93, 94, 95 and 96 respectively connected in series; are each one

of those loudspeaking or telephone-speaking devices, resistance devices? A. No, they are what would be called impedance devices, characterized different from resistance; resistance being only effective for direct current. For alternating current, impedance or reactance devices are employed, and these devices will have both resistance and reactance.

Q. If they are connected in series as there shown, their impedance effect is additive, is it not? A. It is increased. If the three were of 776
the same impedance, the impedance, as far as the tube would be looking into it as much as three times to one.

Q. It is additive; it is the sum total of all three? A. Yes.

The Court: Is that the same thing as cumulative?

Mr. Darby: Yes, sir.

Mr. Ashton: Before you take up the next patent, Mr. Darby, I would like to state that my information is that the 777
audion amplifier which De Forest brought to the Telephone Company in October, 1912, was not a cascade amplifier, but a single tube.

Mr. Darby: I fought through two suits on it so far and one is going to the Supreme Court, and I hold my ground that it was a cascade amplifier according to Mr. Richards and Dr. Arnold himself, before he died, testified to that effect and I will be glad to check it with you.

Q. Now, Weagant Patent No. 1,384,108, item 26 in Fig. 1 of that patent, there is shown the

additional resistance 15 in the output circuit, is there not? A. Yes.

The Court: Fig. 1?
Mr. Darby: Yes, your Honor.
The Court: All right.

Q. Would that resistance have the inherent effect of straightening out the cascade curve of the tube? A. Yes, sir.

779 By the Court:

Q. Is No. 14 the condenser there? A. Yes, 14 is the condenser.

Q. Does that current get to 16 from the output? A. It divides between 16 and 15, those two being in parallel.

Mr. Darby: You see, your Honor, in the output circuit of a vacuum tube, there is both direct current and alternating current. You have to have a path of travel
780 for both; a path of travel for the alternating current is through the condenser, shunting around resistance 15 to the condensers for the reactance, depending on their value and impedance for alternating current, is that correct?

The Witness: Yes.

Mr. Darby: The characteristic wave is more concerned with the direct current and that is the reason why in the patent in suit, we have under consideration, for example,—it is concerned only with direct current because there is no condenser by-pass shown. Therefore, with

reference to the pertinency of the Weagant patent, we can completely forget the condensers and refer only to the direct current path.

Q. Finally on this patent, if you will turn to Hewitt Patent No. 1,393,699, item 28, I call your attention to Fig. 2, which shows the three-electrode audion type of structure. Is there resistance there included in the plate circuit, in addition to its normal load? A. Yes, resistances 782
19 and 20, in series with the translating device 18.

Q. They are both made adjustable so that any desired value thereof may be had? A. They are.

Q. Now, we will take up the Arnold Patent 1,403,475, referred to as resistance capacity coupling patent and the patents to which reference will be made are:

Arnold Patent No. 1,129,942 (tab No. 10).
Nichols Patent No. 1,257,381 (tab No. 783
18).
De Forest Patent No. 1,377,405 (tab No. 25). (This patent was withdrawn; see page 252.)
Arnold Patent No. 1,398,665 (tab No. 26).

If your Honor will turn to the Arnold Patent 1,403,475, I will identify the subject matter of it to your Honor. Claims 8, 9 and 10 are involved in the suit. Claims 8 and 9 cover the resistance 25 and the condenser 26 interposed between the plate electrode 10 of one tube and

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grid electrode unnumbered of the next tube 31. That is the resistance coupling between those two tubes.

The Court: You say that the grid electrode is unnumbered?

Mr. Darby: Yes, that is unnumbered. Claims 8 and 9 cover the resistance 25 and the condenser 26 connected in that arrangement; and claim 10 brings in combination with that of resistance 29 as well.

785 Therefore if you will turn to Arnold 1,129,942 (tab No. 10) and refer to Fig.— by the way, have you made a simplified drawing of Fig. 6 of this patent?

The Witness: I have.

Mr. Darby: I offer the simplified drawing in evidence.

(Marked Defendant's Exhibit H.)

The Court: There are only two tubes in the one I have.

(Copy of Exhibit H submitted to the Court.)

786 Q. Briefly describe the arrangement shown in Fig. 6 of the patent, referring both to the patent and your simplified drawing in connection with it. A. The output from the first tube on the left, plate No. 4, is superimposed across reactance Fig. 17, which is included in the plate circuit between filaments 5 and 4. The alternating current variations appearing between plate 4 and filament 5 are superimposed across the reactance 17. The voltage thus occurring between the ends of the terminal 17 are transferred by means of series condenser 18 and the common filament connection between the two

tubes across the resistance 14, which also includes the grid number 3 of the second tube. The C battery, not marked, between the condenser 18 and 3 grid of the second tube furnishes the necessary negative bias of this combination. The only essential difference between this arrangement and that shown by the patent in suit No. 1,403,475 is in the substitution of a resistance, No. 25 by the reactance 17 in Patent No. 1,129,942.

Q. Referring to the single sheet of drawing of 788
the Arnold patent in suit No. 1,403,475, what element in your simplified drawing Exhibit H corresponds to the reactance or resistance 25 in the patent? A. No. 17.

Q. As I understand it, in the patent, it is shown as a resistance, whereas in the simplified drawing, it is shown as an inductance, is that right? A. That is right.

Q. Has an inductance coil resistance to the flow of direct current? A. An inductance coil always has some resistance, but very little to the flow of direct current. 789

Q. It has reactance to the flow of alternating current, is that right? A. It is.

Q. In the circuit shown in the patent, there is a condenser 24. Now, tracing the path of current from the plate electrode 10 back to the filament in the patent, if there is both direct and alternating current in the plate circuit, it flows to and through the resistance 25, does it not? A. Yes.

Q. And then it branches; the alternating current goes through condenser 24, and the direct current going down through the choke coil 28 and battery 27, is that right? A. Correct.

By the Court:

Q. After passing alternating current 24, where does it go? A. It returns to the filament.

By Mr. Darby:

Q. Therefore, there is both alternating current and direct current in the output circuit, in the circuit arrangement of the patent, is that right? A. That is right.

791 Q. Therefore, if an inductance is used in place of a resistance, it will have its reactance effect on the alternating current, is that right? A. That is correct.

Q. And the condenser 18, in your simplified drawing, does that correspond to the condenser 24 in the patent in suit? A. It does.

Q. I am referring to the lower left-hand condenser 18. A. Yes.

Q. What corresponds to the condenser 26 of the patent in suit? A. Condenser 26 is in the

792 upper part of the simplified drawing.

Q. There is a negative grid bias battery 30 in the patent in suit; what corresponds to that in the simplified drawing? A. The battery shown between the upper condenser 18 and grid No. 3.

By the Court:

Q. Battery C you call that? A. That is battery C, yes.

By Mr. Darby:

Q. What corresponds to the resistance 29 of the patent in suit? A. Resistance 14.

Q. Referring again to this Arnold Patent 1,129,942, that we have under consideration, the vacuum tubes are all amplifier tubes, are they not? A. Yes.

Q. They are all connected in series, are they not? A. You refer to the filaments?

Q. No, I am referring to the tubes being cascaded in series. A. In Fig. 6?

Q. Yes. A. Yes.

Q. And the same is true of Fig. 7? A. In Fig. 7, the last three tubes are in parallel, as 794 far as the grids are concerned.

Q. In Figs. 1 and 2, they are in series? A. Yes, you are correct. They are all in series there, as well.

Q. That is what I thought. A. Yes, they are all in series.

Q. The tubes are connected in series in all of the figures, are they not? A. They are all in series, yes.

Q. What type of coupling is employed between the tubes in all the figures? A. Resistance and impedance coupling in the case of Fig. 795 6; all the others are resistance coupling.

Q. No transformers are used in the coupling throughout, is that right? A. That is right.

Q. Will you turn to the Nichols Patent 1,257,381 (item No. 18); referring to Fig. 3 of this patent as illustrative, I call your attention to two vacuum tubes in the middle of the page; are they amplifier tubes as used in the circuit? A. No. 30 is an amplifier tube and I believe that No. 23 is a detector tube, as described by the text of the patent.

Q. But they are connected in series, are they not? A. Yes.

Q. What type of coupling exists between the output or plate circuit of the first tube 30 and the input or grid circuit of the next tube 23? A. Resistance coupling 31.

Q. Is there likewise a condenser included in that connection between the resistance coupling and the input grid? A. There is.

Q. That is No. 26? A. That is No. 26.

Q. Refer now to the audions 13 and 17; what type of coupling between those audions is util-
797 ized? A. Resistance coupling. Resistance No. 31.

Q. Resistance No. 15 you mean, do you not? A. Oh, you are at the top of the page; yes, resistance 15.

Q. Referring to audions Nos. 17 and 13 connected directly with the line, what type of coupling is employed there between the two audions? A. Resistance coupling.

Q. Referring now to the bottom of the page, audions Nos. 30 and 23, what type of coupling is employed there between the audions? A. Re-
798 sistance No. 31.

Q. And is there a condenser 26 likewise located between the resistance coupling and the grid? A. There is.

Mr. Darby: I will withdraw reference to De Forest Patent 1,377,405.

Q. I call your attention to Arnold Patent 1,398,665, Item No. 29. In an ordinary audion amplifier circuit, you put a telephone receiver in the output circuit on the last two of the series, is that right? A. Yes.

Q. That is, the telephone receiver or loud-

speaker device or some other reproducing devices? A. Something of that sort.

Q. If I want to add an additional stage of amplification, what do you do? A. You provide some means of coupling between the preceding stage and the next stage.

Q. That is, you take out the receiver and put a coupling connection in place of the receiver and leave that in to the input of another audion tube, is that correct? A. Correct.

Q. Has that been well known throughout the 800
years that audion amplifiers have been used, to your knowledge? A. As far as I know, yes.

Q. Refer to the Arnold Patent, Item No. 29, what is the device 8 in the wiring diagram there shown? A. Device 8 is a reactance.

The Court: That is Fig. 3?

Mr. Darby: Yes, your Honor.

Q. And the device 9 is another way of illustrating a condenser, is that right? A. Correct.

Q. Now, take up the Arnold Patent 1,448,550, 801
known as Definite Input Impedance Patent, and the art which will be referred to in connection with that is as follows:

Colpitts Reissue Patent 14,380, Item No. 17.

Colpitts Patent 1,129,959, Item No. 12.

Van Der Bijl Patent 1,350,752, Item No. 23.

Arnold Patent 1,398,665, Item No. 29.

Johnson Patent 1,432,863, Item No. 31.

Mr. Darby: If your Honor will turn to the patent in suit, which is tab No. F, I

will recall to your Honor's mind that all that is necessary in order to infringe this patent is to put an impedance across the element 6, impedance in shunt to or connected across the input circuit of the audion tube. It is a resistance.

Q. Referring to Colpitts Patent, Item No. 17, I call your attention to Fig. 3 of this patent; is there there employed a resistance connected
803 across the input circuit and in shunt, to the input inductance? A. There is. No. 26.

Q. If the resistance connected across the input circuit to the vacuum tube is going to establish a definite input impedance, will any resistance so connected across the line establish a definite input impedance, depending on the value of the resistance used? A. It will.

Q. I also call your attention to Fig. 2. Is there an input impedance there connected across the line? A. There is, No. 14, adjustable.

Q. I will correct you on that; it is No. 26.
804 A. Oh, that is right, 26. No. 14 refers to the transformer. I beg your pardon. It is No. 26.

Q. And it is shown adjustable? A. It is shown adjustable.

Q. So that any desired value of resistance, within the value of the resistance coil itself may be chosen at will? A. That is correct.

Q. I call your attention to Fig. 4; is an input impedance there used across the grid electrode of two tubes connected in parallel? A. There is. Both of them are marked 26.

Q. And both of them are shown adjustable so that any desired value may be used? A. That is correct.

By the Court:

Q. Does the adjustment of one necessarily regulate the adjustment of the other? A. Not necessarily.

Q. It would seem so from the drawing, but I do not say that it is true. A. They should be adjusted for balance in this particular circuit. The reason they have two is to balance them with regard to the two tubes.

806

Mr. Darby: I think what the witness has in mind is this: Due to the fact that the common lead and filament is between them, the circuit of the input, that is the input circuit of one tube extends from the grid 13A, for example, down through resistance 26 to the battery 16, and then to the filament. That is a complete circuit.

The Court: I see.

By Mr. Darby:

807

Q. So that you could adjust that ordinarily so as to control the input circuit of 13-A without in any way affecting the input circuit of the tube 1-B, but in the particular arrangement elsewhere in the circuit, these tubes are described as being balanced and therefore it would not be done; is that correct? A. You can make adjustments there to affect one of the tubes, but whatever adjustments you make on there,—on either one will change the definite input impedance looking in from No. 19.

Q. Now, will you look at Colpitts Patent No. 1,129,959, Item No. 12?

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Mr. Darby: This is a patent of the prior art to which I have already called your Honor's attention, and it is in connection with this patent in suit that we are now considering, that I ask your Honor to refer to claim 1 of this patent. It reads:

"The combination with a low impedance source of varying currents and a receiver adapted to respond to such cur-
809 rents, of an amplifying repeater connected with said source and having an output circuit of high impedance compared to said source, and a second amplifying repeater connected between said first repeater and said receiver and having an input circuit also of high impedance, compared to said source."

Having in mind that this patent starts with the statement:

810 "A well known law of electric circuits requires that the impedance of the external path in the circuit should be equal to the impedance of the internal path or source, whenever the maximum of available energy is desired."

The Court: What is the patent in suit?

Mr. Darby: Arnold Patent 1,448,550.

The Court: Let me see claim 1 of that.

Mr. Darby (Reading):

"The combination of a vacuum discharge repeater of the three-electrode type, and inductive coil conductively connected to the input electrodes of said re-

peater, and a conductive impedance in shunt to said coil."

Q. Now, is there a conductive impedance connected across the input electrodes of the bank of audion tubes shown in Fig. 1 of this patent? A. There is.

Q. Name it, please. A. No. 55 and No. 53.

Q. And it is described in the patent as being provided for the purpose of effecting balance? A. I believe it is.

812

Q. Will you now refer to Van Der Bijl Patent No. 1,350,752, Item 23, referring to Fig. 4, is there an input impedance connected across the input electrodes of the vacuum tube 2 in this circuit arrangement? A. There is, No. 10.

Q. And what is the transformer coil? A. The transformer coil, No. 17, is for the purpose of transferring the alternating current variations of microphone 15 to the grid No. 5 of tube No. 2. Included in this input, is another transformer No. 12 that superimposes upon this audio frequency current, radio frequency alternating current to No. 14, the generator—

813

Q. In other words, the circuit which includes one coil of the transformer 17 is the source of current to be amplified, is that right? A. That is right, one of the sources which amplifies both the audio and the radio.

Q. And the impedance 10 is connected across the input electrodes comprising the grid 5 and the filament 3, is that right? A. That is correct.

Q. This patent points out, in line 20:

"The invention provides for modulating feeble high frequency oscillations by

impressing the currents of telephonic frequencies, together with the high frequency oscillations, on the input circuit of a thermionic amplifier; and makes use of the fact that the amplification of a thermionic amplifier of the audion type depends upon the voltage impressed upon the grid or input circuit. If the amplifying power of the tube for the high frequency oscillations is caused to vary in accordance with
815 the variations of the electromotive force of the telephonic waves of low frequency, the desired modulation is obtained, for there will be produced a high frequency wave the envelope of which is an accurate reproduction of the telephonic wave, and this wave may then be further amplified to any required degree for effective radiation from an antenna."

That has to do with radio telephone transmission, is that right? A. Yes.

816 Q. And that is the use to which the inventions of the patent in suit was put in radio messages, to Paris, Spain, Honolulu, Canal Zone, and so forth, is that correct? A. That is correct.

Q. In this particular use, they would handle high frequency as well as low frequency, is that right? A. That is correct.

Q. And the vacuum tube handles high frequency and low frequency, does it not? A. It does.

Q. So that in so far as the function of the tube is concerned, it does not make any difference whether it is radio frequency currents it is

handling or audio frequency currents? A. It does not.

Q. In other words, was my statement correct? A. As far as the function of the tube is concerned, it is only the associated circuits which determine whether or not the tube is handling radio frequency or audio frequency.

Q. In other words, if I wanted to use a vacuum tube for radio frequency purposes, I would connect in the input and output circuits, instrumentalities that were designed and built with 818
physical and electrical characteristics capable of handling radio frequency currents, is that right? And if as here, in the defendant's apparatus, I am only going to use audio frequency currents, then the instrumentalities employed in the circuits of the audion, are of audio frequency design, is that correct? A. Yes. Of course, there are exceptions to this. There are some tubes that are better adapted for radio than audio, and vice versa. There is no universal tube.

Q. In other words, while all tubes are the same in general principle of construction, consisting 819
of a filament or cathode, grid and plate, the physical structure of those various elements may differ in accordance with the specific purpose for which it is to be used, is that right? A. That is right.

Q. That is the reason why, in defendant's apparatus, for example, as well as in all similar equipment, tubes of different types, such as 201-A, 227, 226, 250, 280 and 281 have been built, all differing from each other in detail of construction, depending upon the particular use

to which they are to be put? A. That is correct.

The Court: Any time you don't want to agree with Mr. Darby's testimony, just tell him so.

Mr. Darby: That is all right, he has to be cross examined on it.

The Court: That is just it, if you were to be cross examined on it, it would be

821 better.

Mr. Darby: I might say this, your Honor, there is really no dispute about these things, and the reason I go about it in this way, is because I want to get it in as speedily as possible.

Mr. Ashton: I think there is a great deal of dispute on a great deal of it.

The Court: If there is no dispute, all you have to do is to stipulate the adjudication of the case.

Mr. Darby: In this connection on the

822 Van Der Bijl patent, I will ask your Honor to mark claim 10 as well as claim 20 for future consideration. Likewise, if you would mark page 2, line 76, where this device 10 is referred to as a potentiometer, and likewise beginning at line 106 and extending down through line 123.

The Witness: Are you correct in that? Isn't that 86 that you were referring to as a potentiometer?

Mr. Darby: No, line 76.

The Witness: Oh, yes, that is correct; it is also in line 88.

Q. There is one more patent that I will refer to. Johnson Patent, No. 1,432,863. I call your attention to Fig. 1 of this patent and to the resistance 12 connected across the line, prior to reaching the transformer 5. Does the resistance located in the line prior to reaching the resistance 5 affect the impedance in the input circuit impressed upon the grid and filament electrodes of the first audion 8?

The Court: Will you read that question? 824

(Question read.)

A. Yes, I would say that it does affect it.

Mr. Darby: If you will turn to the patent tab C, your Honor, which is the Arnold Patent No. 1,349,252, in Fig. 5, just such an arrangement is shown where through a transformer the effect of resistance is impressed upon the plate filament circuit. 825

The Court: That is on the output circuit; this is on the input?

Mr. Darby: That is right.

Q. Now, taking up Arnold Patent 1,465,332—

Mr. Ashton: Before you do that, I just want to remind the Court that Mr. Kendall's testimony the first day of the trial, we showed the date of the invention of this 1,448,550 patent was at least as early as March, 1914.

Mr. Darby: No, they have put in evi-

826 *Raymond T. Cloud—For Defendant—Direct.*

dence tending to show that, but they have not shown it, under the well-established law necessary to carry date of invention back.

Arnold Patent 1,465,332, which is characterized as the Common Plate Supply Patent which is tab G, your Honor will recall, that the asserted invention of this patent is utilization of a single source of current for supplying of the plates to the
827 audions. Mr. Waterman expounded at some length what great practical advantages ensue if you don't have to have separate plate battery for the audions used.

The patents that will be relied upon and utilized on this are:

Arnold Patent 1,129,942, tab No. 10.

Campbell Patent 1,227,113, tab No. 15.

Alexanderson 1,340,101, tab No. 21.

If your Honor will turn to tab 10, the Arnold patent first referred to—

828 Mr. Ashton: I call your Honor's attention to the fact that the Campbell patent has not been cited against this patent.

Mr. Darby: Yes, it has been cited. These were all cited; they were all cited in the bill of particulars. Whether or not it was cited against this patent is wholly immaterial.

Q. Turn your attention to Fig. 6 in this patent—

The Court: That is tab 10?

Mr. Darby: Yes, your Honor.

Q. Referring to Fig. 6, how many batteries are employed for supplying the plate electrodes of the various tubes there shown? A. There is one battery, No. 13.

Q. And how many plates? A. There are three plate circuits furnished from this one battery.

Q. In Fig. 6? A. In Fig. 6.

Q. And in Fig. 7, how many batteries are employed for supplying the space current to the 830
plate electrode? A. There is one battery supplying the five tubes.

Q. And is any mechanism employed for smoothing out the current? That is, is there an inductance or a choke coil connected between—
A. In Fig. 6 there are chokes 17 in each instance.

Q. Are the chokes shunted by condensers? A. In the first two tubes they are shunted by condensers No. 18. I have a simplified circuit drawing of that if you wish to use it.

831

Mr. Darby: I offer in evidence simplified circuit that the witness has drawn of Arnold Patent No. 1,129,942 as to Fig. 6. (Marked Defendant's Exhibit I.)

Q. Have you used the same reference characters in your simplified drawing that are used in the drawing of the patent? A. Yes, I believe so. The same numbers appear.

Mr. Darby: I call your Honor's attention to the statement contained on page 3 of the patent, line 5:

"Fig. 5 shows a simplification of the system illustrated in Fig. 4, in that a common battery 12 furnishes current to all the filaments, said filaments being connected in series with the battery, and a common battery 13 serves for all of the plates."

Q. I call your attention to Campbell Patent 1,227,113, Item No. 15; will you please briefly
833 point out what pertinency the disclosure of this patent has to the subject matter under consideration? A. Campbell's patent refers to transmitting certain frequencies or bands of frequencies without attenuation, while attenuating adjoining or nearby frequencies very highly, that such frequency being undesired in the type of device in this case which is telephone connected to a repeater.

Mr. Darby: I will ask your Honor, if you will just mark for consideration at
834 your convenience, beginning on page 1, line 17 to and including the end of the sentence at the top of the second column.

The Court: Why don't you have this witness expound it rather than have me look at it at my convenience?

Mr. Darby: Very well, your Honor.

Q. Will you explain what is meant by the subject matter, or expound the subject matter contained between lines 17 and 48? A. The idea is by holding certain relations between the elements that go to make up a network, so that all the phenomena of resonance and anti-resonance,

—by "resonance" meaning an inductance and capacity in series; and by anti-resonance, an inductance and capacity in shunt, so formed and arranged that they will pass certain pre-arranged frequencies and will reject certain unwanted frequencies. This is done in a number of different ways. As a matter of fact the filter theory as applied to telephone lines, is an extremely complicated phenomenon.

The Court: That is what I thought. That is why Mr. Darby passed it along to me to read it at my convenience. 836

The Witness: I do not think it is really pertinent to go into the full theory, because we would be talking here all next week if we did.

Q. Could it be summed up with this statement— A. A simple statement would be in this case, by means of a choke we hold back alternating current frequency, and by means of a condenser we by-pass them in the direction that we wish them to go. We keep them out of one 837 portion of the circuit and pass them into another.

Q. Is this principle utilized and has it been utilized for a great many years, in order to smooth out a current source so as to make it constant in its supply? A. Yes, especially in power supply systems.

Q. The last patent I refer you to on this subject matter here is Alexanderson Patent 1,340,-101, Item 21. Referring to the plate circuits of each of the audions there shown, what is the source of space current for the plates? A. Generator No. 1, alternating current generator.

838 *Raymond T. Cloud—For Defendant—Direct.*

Q. 1 generator supplies the plate current to all the tubes, does it? A. Yes.

Q. Finally taking up the last one—

The Court: Suppose we take that up next Tuesday.

(Adjourned to February 13th, 1934; 10:30 a. m.)

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February 13, 1934.
10:30 A M.

Q. We will complete our consideration of the art relative to the patents in suit, by considering Arnold Patent No. 1,520,994, tab H. In connection with this patent, will you turn first to Von Lieben, tab No. 6, Patent No. 1,038,910.

Mr. Ashton: Do you want to state first, Mr. Darby, which ones you are going to rely upon?

840

Mr. Darby: I will. The remainder of the patents relied upon in connection with this disclosure are:

Pierce No. 1,127,371, tab No. 9.
Colpitts No. 1,137,384, tab No. 13.
Kendall No. 1,330,470, tab No. 20.
Van Der Bijl No. 1,350,752, tab No. 23.
Johnson Patent No. 1,432,863, tab No. 31.
Arnold Patent in suit, 1,448,550, tab F.

Q. Now, referring to tab No. 6, the Von Lieben & Reisz patent, will you please briefly describe

what is there shown that is pertinent to this patent in suit? A. In Fig. 3, there is a potentiometer marked C for dividing voltage across the filament to bias the control element H. The same arrangement as shown in Fig. 2 with similar lettering. 841

Q. In this particular arrangement, the potentiometer is not connected across the input circuit, is it? A. No, it merely shows the use of the potentiometer for dividing voltages.

Q. In connection with vacuum tubes of the audion type? A. Yes, sir. 842

Mr. Ashton: Did you say the audion type, Mr. Darby?

Mr. Darby: I did say it. If there is anything wrong with it, will you let me look at it? Yes. Audion type.

Q. Now, turn to Pierce patent, tab No. 19; will you please similarly point out what is there shown relative to this patent we have under consideration? A. In Fig. 2 a potentiometer, 62, is shown across battery 61, for dividing the voltage of battery 61, the bias or grid No. 13 of the audion type tube. 843

Q. Between what electrodes is the potentiometer connected? A. The potentiometer is connected between the filament and the grid, provided the relay contact No. 54 is made. There is a relay there for opening and closing, and that relay, to make a contact on the back side to the potentiometer is in the circuit, that is not exactly in between, because the secondary of 23 is in series with it.

Q. You say the secondary of 23 is— A. Trans-

former 23 is in series with the potentiometer. The potentiometer and the secondary of the transformer is between the filament No. 14 and grid No. 13. You can follow that circuit out from 14 through conductor 26, through the secondary of the transformer 23, through the top conductor No. 50, No. 55, contact No. 54 of the relay, contact No. 63 of the potentiometer through conductor No. 56 to the grid No. 13.

Q. And is the connection to the potentiometer
845 illustrated as adjustable, so that its effect may be varied at will. A. Yes, it is adjustable. Contact 63 will adjust the potential of battery 61 to get any desired potential on grid No. 13.

Q. Now, will you refer to Colpitts Patent No. 1,137,384, tab No. 13. Refer first to Fig. 2. Will you please trace the input circuit of the audion No. 1? A. The input transformer of audion No. 1 is No. 15,—marked No. 15 on the drawing, primary No. 19, secondary No. 14. Shunted across this transformer is an adjustable resistance No. 14.

846 Q. No. A. No. 26; also a battery No. 16. The contact on the adjustable resistance can be adjusted to put any resistance across the secondary of transformer No. 15. Connected to the contact is the grid 13 of the tube, and the input circuit is between the filament of the tube to the grid.

Q. And is the resistance 26 connected—

The Court: Just trace that input circuit.

Q. Start from the grid and trace the input circuit. A. From 13 to contact 26, it is in paral-

lel with it through the secondary of the transformer No. 14, through the condenser not marked to the filament No. 7.

Q. And the battery 16 is likewise in that input circuit, is it not? A. Yes, the battery 16 and the adjustable resistance 26 is in shunt to the input circuit.

Q. Is the adjustable resistance 26 as there shown, a potentiometer? A. No, it is not.

Q. Now, will you refer to Fig. 3? A. Yes.

Q. Before taking up consideration of Fig. 3, 848
will you just explain in a few words, in what respect the arrangement shown in Fig. 2 differs from a potentiometer? A. It differs from a potentiometer inasmuch as that one end of the resistance is free and is not connected across any device. With the top end of that potentiometer connected to the wire immediately above it and connection between No. 26 and No. 15 to the transformer,—secondary 14 rather, removed, it would be a potentiometer arrangement.

Q. Now, referring specifically to Fig. 3, I no- 849
tice that the resistance 26 is completely connected across the input circuit. Is that correct? A. That is correct.

Q. In other words one of the deficiencies that you mention with respect to the showing of Fig. 2, to make it a potentiometer, has been there supplied; is that right? A. Yes.

Q. The resistance 26 is not shown as variable, is it? A. No.

Q. And there is no adjustable output from the grid electrode to the resistance 26, is there? A. No.

Q. Is the arrangement shown in Fig. 3 a potentiometer? A. No.

Q. Referring now to Fig. 4, is the arrangement there shown with respect to the resistance 26 a duplication of the arrangement shown in Fig. 2, as applied to two tubes in parallel? A. Yes, as far as the input to the tubes is concerned —the input circuit to the grids.

Q. Is the arrangement shown in Fig. 4, insofar as the input circuit resistance is concerned,
851 a potentiometer arrangement? A. No.

Q. Will you now please refer to Kendall patent No. 1,330,471, tab No. 20. I call your attention to Fig. 4 of the patent and the last tab of the series. Will you please trace the input circuit of the last tube, starting from the grid electrode 87? A. Starting from the grid electrode 87 through the C bias battery 93 to the contact of the potentiometer 84, which is in shunt across the secondary 83—the transformer itself not being numbered. The circuit divides at the contact of the potentiometer 84, part of it going
852 through the secondary 83, the remainder through the lower half of the potentiometer to the filament 86.

Q. Insofar as the use of a potentiometer in the input circuit of a vacuum tube is concerned, what difference exists between the disclosure of the Kendall patent and the disclosure of the Arnold patent in suit No. 1,520,994, tab H? A. None whatever.

Q. They are identical? A. They are identical.

Mr. Ashton: I point out, your Honor, that is the patent which the witness Ken-

dall testified he learned the invention of from Dr. Arnold.

Mr. Darby: Your Honor will understand I am deferring my argument until later.

Q. Will you now refer to Van Der Bijl Patent 1,350,752, tab No. 23. Referring to Fig. 4, will you there trace the input circuit from the grid to the filament? A. From grid 5, through the secondary 11 of transformer 12, to the contact or movable contact point of potentiometer 10. The circuit there divides, a portion thereof going through the secondary of transformer 17, the remainder through the lower half of potentiometer 10 to the negative pole of the bias battery 7; thence on the positive side of bias 7 to the filament 3. 854

Q. What is the source of currents to be amplified in this arrangement? A. The source of currents to be amplified is a combination of voice frequencies or audio frequencies from transmitter 15 and the radio frequency generator 14. The two are combined on grid 5 to perform what is called modulatior in radio frequency transmission. 855

Q. Insofar as the inclusion of a potentiometer connected across the input electrodes of a vacuum tube is concerned, in what respect if any does the disclosure of this patent differ from that of the patent in suit, tab H? A. It differs in no respect from the patent in suit. It is placed there for the purpose of regulating the volume of the audio frequency input to the tube.

Q. What is the purpose of the use of the

potentiometer in the input circuit of the patent in suit? A. It is the same thing.

Mr. Darby: I will ask your Honor to mark the passage beginning at line 20, the first page of this patent. I would like also to call your Honor's attention to the illustrative claims of this patent, as Claims 10 and 20.

Q. Will you now refer to the Arnold patent
857 in suit, tab F, Patent No. 1,448,550, and I call your attention to the resistance 6 included in the input circuit of that patent. Is that a potentiometer? A. No, that is not a potentiometer.

Q. What would be necessary if it was desired to use that as a potentiometer? A. It would be necessary to place contacts along the resistance to which the grid would be connected, instead of to the upper end of the resistance as shown.

Q. In other words, am I correct in understanding you that if the connection from the positive end of the biasing battery 4 was dis-
858 connected from the top of the resistance 6 and made slidable along it, that would make that a potentiometer? A. It would.

Q. How long have you been familiar with the use of a potentiometer in the vacuum tube art? A. Well, that is difficult to say. I cannot place it.

Q. But is a potentiometer something that you have just recently become familiar with? A. No. In connection with vacuum tubes the first use of a potentiometer was for dividing the voltage of the batteries, as shown in some of the patents we have cited. It has long been used for regulating volume, but I cannot place the date.

859

Q. As an instrumentality in the electrical art was it well known prior to 1915? A. Well known as a divider of voltages.

Q. Will you now please refer to Johnson patent No. 1,432,863, tab No. 31. I call your attention to the arrangement shown in Fig. 1, the resistance 12. Is that a potentiometer there shown? A. No.

Q. Is its effect on the input circuit of the audion tube 9 relayed through the transformer 5? A. Yes.

860

Q. What would be necessary to make the resistance 12 a potentiometer? A. We would connect the lowest side to the line 3 and disconnect line 3 from the lowest side of the primary 4 of transformer 5, so that the variable voltage across resistance 12 would be impressed upon the primary of transformer 5 by means of the adjustable set on the resistance.

Mr. Ashton: Mr. Darby, I assume that that you are not relying upon or putting in evidence the following patents, which have not been mentioned; namely, Langmuir 1,313,094; De Forest 1,348,157 and Reisz 1,418,022?

861

Mr. Darby: I did not intentionally overlook any. If you will give me a minute I will answer your question, Mr. Ashton.

Mr. Darby: That is correct, Mr. Ashton, as to two of them. I am not offering in evidence Langmuir patent 1,313,094, tab No. 19; I am not offering in evidence Reisz 1,418,022, tab No. 30. I am not offering in evidence De Forest 1,348,157, tab No. 22.

Mr. Ashton: All three of them?

Mr. Darby: All three of them.

Mr. Ashton: I would like to ask Mr. Darby if he is relying on any of these patents for double-patenting?

Mr. Darby: Yes, as pleaded. In other words, it will take some time. There is a mass of these patents, and they are so overlapping it will take some time to dig them out for you; but I have furnished a
863 bill of particulars in the case, in which I have classified them.

Mr. Ashton: I believe Mr. Darby has in mind the one he spoke to me about in his office. I think it was Patent No. 1,448,-550 as against the patent in suit No. 1,520,-994.

Mr. Darby: I claim that Arnold Patent No. 1,349,252 is invalid because of double patenting, in view of Arnold Patent 1,329,-283, and that Arnold Patent No. 1,448,550 is invalid in view of double patenting of
864 the same Arnold Patent 1,329,283. I think that is all.

Cross Examination by Mr. Ashton:

Mr. Ashton: Your Honor understands that we noted our objection the other day to the use of any of these patents except those pleaded in the bill of particulars and we do not wish it to be taken that in the cross examination on these patents that we are foreclosed from our position.

Mr. Darby: You will note, Mr. Ashton,

that three of the patents to which you objected have been withdrawn.

Q. Did you once work, Mr. Cloud, for one of the telephone companies? A. Yes, I worked for the South Western Bell Company and for the Illinois Bell.

Q. About when was that? A. I also worked for the Western Electric Company in 1905. Prior to 1905, I worked for the Western Electric Company. In about,—I don't remember the exact 866
date, in 1906, I went to work for the South Western Bell Telephone. In April, 1912, I went to work for the Illinois Bell, which was then the Chicago Telephone Company.

Q. Just roughly, what was the nature of your work for these companies? A. With the Western Electric Company, I was erecting and installing switchboards, doing circuit work and power installations.

With the South Western Bell, I was chief switchboard man, wire chief, inspector of the Inspection Division of the State of Texas. 867

Q. You were in the operating department? A. I was in the operating department. I was plant engineer for Northeast Texas.

Q. In charge of the handling of the plant? A. Of all switchboard and of all plants.

Q. I believe you testified that your work has been principally in connection with talking motion pictures since 1928, is that correct? A. That is correct.

Q. With what company were you connected in 1928? A. In 1928, I was doing work in spare time only with Mr. Harley L. Clark, who later became president of Fox, in connection with

what is known as the Orchestra Phone Company. I was merely consultant.

Q. Did that company supply talking motion pictures? A. It supplied not talking motion pictures, but incidental music for picture theatres.

Q. What other talking motion picture connections have you had since that time? A. Since that time, I have been with Jenkins & Adair.

Q. What was their business? A. They made
869 recording equipment for talking pictures—recording cameras and amplifiers.

Q. Did you have something to do with the amplifiers? A. Yes, I had something to do with the amplifiers, although my particular feature was not exactly talking pictures at that time; it was with a special recording device not being used in talking pictures.

Q. What was your next connection? A. My [redacted] connection was with E. N. Zelony in connection with talking pictures and amplifying equipment.

870 Q. Who was Mr. Zelony? A. Mr. Zelony represents Jenkins & Adair, and he is also sales representative of the Amatran—American Transformer Company.

Q. Are you an officer of that company? A. Yes, I am an officer of that company.

Mr. Darby: Which company do you mean?

The Witness: I am chief engineer of E. N. Zelony.

Q. Chief engineer? A. Yes.

Q. Does that company supply amplifiers for

talking motion pictures? A. Yes, they have supplied amplifiers for talking motion pictures. The amplifiers in question, were sold through them, I understand, although at that time I was not with them.

Q. What time was that? A. Prior to 1933.

Q. When did you come with them? A. The first part of 1933—a little more than a year ago —about a year ago.

Q. What was the business of the company at that time? A. It was the same. It is a sales 872
organization and an engineering organization.

Q. Does it make any amplifiers itself? A. Yes, we have made amplifiers.

Q. Just tell me what amplifiers it makes and what they are sold for.

Mr. Darby: Just a minute, I do not think that is proper cross examination. Mr. Ashton apparently is laying the foundation for another suit.

Mr. Ashton: Nothing of the kind, your Honor. This witness testified that he is 873
now with a company that is making amplifiers that probably use the inventions of these patents. It may be that we might want to sue them. I want to know exactly what his connection is with this talking motion picture art, in particular with amplifiers, which he has been testifying about here.

The Court: In other words, you are examining him on his qualifications?

Mr. Ashton: That is included, your Honor.

Mr. Darby: If he attacks his qualifica-

tions, that is one thing, but I ask that the nature of his questions be carefully scrutinized, to see whether it has a bearing on the question. Will you please read the question, Mr. Stenographer?

(Question read.)

Mr. Ashton: He testified that he was chief engineer of this concern, Mr. Darby, making these amplifiers.

875 The Court: Is there any way by which you can make your question a little more pointed, in the light of the fact that the witness is engaged in the manufacture and sale of amplifiers that employ such amplifiers as are here in suit?

Q. Did you make amplifiers such as here in suit by Zelony? A. Yes.

Q. Then you know what those amplifiers contain? A. Yes.

Q. Do they contain a negative grid bias?

876 Mr. Darby: I object to that, if your Honor please. I do not believe that goes to his qualifications at all.

The Court: He has identified the negative grid bias in several of these patents and explained its function. I cannot probe the mind of examining counsel, but on the surface of things, it would seem to me to be a competent question, wouldn't it?

Mr. Darby: I submit respectfully that it would not. How can a question, no matter how it is answered, of that character test the qualifications of this man?

The Court: Simply in relation to his

familiarity with the device and the opportunity that he had to observe it, probably.

Mr. Darby: Any question asked of him to show that he is familiar with the device, is proper, of course; any question directed to finding out what experience he had with a device operating with a negative bias, is proper; but the mere question, did the device which was manufactured and sold by your company contain 878
a negative bias, I submit does not go to the qualifications of the witness at all.

Mr. Ashton: I think it is perfectly clear that this witness has come here as an impartial witness, he is engaged in designing and selling—

The Court: Impartial?

Mr. Ashton: Yes, to tell the Court.

The Court: Yes, but experts are not impartial, as a rule.

Mr. Ashton: I think it bears directly on his partiality to show that he is interested 879
to have these patents knocked out.

The Court: That is his purpose in testifying, of course. I do not believe anybody is mislead by the "impartiality" argument.

Mr. Ashton: It is perfectly proper, in view of that fact, it seems to me.

The Court: Let us straighten the matter out once and for all, by having you state the purpose of your question.

Mr. Ashton: The question bears not only on his qualifications, but also on the question of whether or not he is directly

interested in business, so far as these patents are concerned.

The Court: With respect to the latter half, I am not interested, and I will sustain the objection. If your purpose is to ascertain any facts of that nature, I will have to ask you to re-form your question, please. Then confine yourself to the witness' qualifications as an expert.

881 Q. Will you state whether you designed these amplifiers entirely yourself or whether other people assisted you? A. In some cases entirely myself; in other cases other people have assisted me.

Q. Those amplifiers are now being sold for talking picture purposes? A. We have only made one amplifier for talking picture purposes.

Q. Have you sold that to the defendant? A. No.

Q. Has it been used? A. Not commercially.

Q. Merely for demonstrating purposes? A.
882 Merely for demonstrating purposes.

Q. And does your company have any connection with the defendant in this case? A. No, not as a company. E. N. Zelony & Company, Inc., is a new company and it has only been in existence about six months, and my company has not sold any equipment to the defendant since it has been organized.

Q. Have you had any connection with the defendant other than working on this case? A. None whatever.

Q. Do you have an office at the same address as the defendant? A. Next door to them.

Q. Did you ever submit an amplifier to the

Fox Film Company for the Fox Corporation? A. We never submitted an amplifier to Fox; we have brought amplifiers to the Fox organization for test.

Q. What was the purpose of that? A. The purpose of that was to construct an amplifier that would not infringe the patents of the plaintiff.

Q. The patents of the plaintiffs here in suit? A. The patents of the plaintiffs here in suit.

Q. What was the result of those tests; was the amplifier admitted? 884

Mr. Darby: I object.

The Court: Objection sustained and exception.

Q. You testified, Mr. Cloud, that you were patentee of a number of patents, did you not? A. Yes.

Q. And you stated that some of those patents had to do with things similar to the subject matter here involved? A. I did.

Q. You were the patentee of this patent 1,- 885
907,741, of May 9, 1933, which I note states that one-half has been assigned to Emanuel N. Zelony. A. I am.

Q. Does this patent disclose a negative grid bias? A. Not in the sense of the Lowenstein patent.

Q. It was a patent to get around the Lowenstein invention if possible, was it not? A. It was.

Q. Did you submit that to the Fox Company?

Mr. Darby: I object.

The Court: What is the purpose of that?

886 *Raymond T. Cloud—For Defendant—Cross.*

Mr. Ashton: The purpose of this, your Honor, is here we have a patentee trying to escape the Lowenstein invention as late as 1930 and I wish to point out several features and ask him about this patent, that has a direct bearing on the Lowenstein invention.

The Court: I can understand that, but I do not understand what the connection of the Fox Company has to do with it.

887 Mr. Ashton: I want to know if they adopted it after he submitted it.

The Court: Why don't you subpoena them and ask them?

Mr. Ashton: Very well.

Q. Does this patent not admit at page 3, line 50, that the potential of the grid is constantly varied?

Mr. Darby: I object, if your Honor please, irrelevant and immaterial.

The Court: Is not that the basic theory
888 of all these patents, that the potential and the grid vary and necessarily so?

Mr. Ashton: Under the arrangement which he has in his patent, your Honor, the potential of the grid, which he seeks to maintain there, is a constantly varying potential, being the potential of the Lowenstein patent which is designed as a definite negative potential, that is, without the signal. What is confusing your Honor, is the signal which comes in on that input circuit. The Lowenstein patent goes to putting a negative bias on the grid which is a definite bias, until such

time as the signal comes in. In this particular patent, this device which the patentee uses permits the grid to become positive when certain signals are impressed upon the grid, and it is that which he is seeking to overcome. He is trying to compensate for that without using the Lowenstein invention. Now, the prior art in this case which Mr. Darby is relying upon, shows some of the same instrumentalities which Mr. Cloud uses in this patent 890
and it has a direct bearing on the inventions of the prior art also.

The Court: If you were suing on the Cloud patent, I could see the purpose of it, but you are not.

Mr. Ashton: This patent not only refers to the desirability of having a negative bias of a grid such as Lowenstein disclosed, but shows that this expert was trying to get around that invention as late as 1930.

The Court: He has told you that. He 891
told you that he sought to accomplish the same object Lowenstein accomplished, but in a different way. Isn't that what his testimony is?

Mr. Ashton: I believe he has said that. I want to refer to the particular parts of the patent.

The Court: That is the basic fact. Why corroborate it?

Mr. Ashton: I will offer the patent in evidence later, your Honor.

Q. I wish you would state whether these patents which I read to you are also your patents:

Patent No. 1,907,741. A. I have no copy of that. I have a copy in my case, I believe. That is, yes.

Q. Patent No. 1,831,589 also? A. Yes.

Q. Patent No. 1,767,277? A. Yes.

Q. Patent No. 1,827,970? A. Yes.

Q. Patent No. 1,864,890? A. Yes.

Q. And No. 1,751,978? A. Yes.

Q. It is true, is it not, Mr. Cloud, that it is particularly important where large undistorted
893 output is needed for talking motion pictures and public address systems, to use the invention of the Lowenstein patent? A. No.

Q. It is not? It is common practice to use it, is it not? A. It is common practice, but it is not essential.

Q. That is not what I asked you. A. It is common practice, yes.

Q. Is it also important in public addresses and talking motion pictures to reproduce substantially the piano range of frequency? A. Yes.

Q. Or even greater? A. Even greater.

894 Q. I believe you testified, did you not, that your first connection with vacuum tubes was around 1915, was it, or later? A. My first connection with vacuum tubes was—I first became interested in 1912 on hearing a lecture by Professor Millikan, and soon after that, I commenced to experiment with vacuum tubes, circuits, and so on. About 1915 or 1916, I think was the first time that I really seriously experimented with wireless.

Q. I wish you would please select the reference which you think is the best reference against the Lowenstein patent.

Mr. Darby: I object to that question, if your Honor please. I don't think that is proper practice in this court to require and expert to make such a selection.

The Court: I have heard it done frequently.

Mr. Darby: I have heard it done both ways.

The Court: I think it is quite helpful to the Court to have an expert indicate patents which most nearly approximate the 896 patent in suit.

Mr. Darby: It will perhaps be necessary for the witness to review each one of these patents before he answers the question, and that may take some time.

The Witness: I can answer this one.

The Court: I do not think he will improvise his theory now.

Mr. Darby: No.

The Witness: I believe De Forest Patent No. 841,387, tab No. 1.

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Q. Is it true that the only two batteries in this patent whose polarities are not given are B^{11} in Fig. 2 and B^{111} in Fig. 4? A. Yes, I believe that is so.

The Court: I would like to have that question read again, please.

(Question read.)

Q. Does not the battery B^{111} furnish current in Fig. 4 for the microphone T^{111}? A. It is not a microphone. Oh, in Fig. 4?

898 *Raymond T. Cloud—For Defendant—Cross.*

Q. Yes. A. Yes, the battery B^{111} furnishes power for the microphone T^{111}.

Q. Is it not true that in some of the figures of the patent the long line battery symbol indicates plus and in others it indicates minus? A. That is true.

Q. Do you know whether it was common at this time in 1906 to have sensitizing batteries for detectors? A. Yes. In all probability it was. I think it was common. That was before I had any

899 direct experience with it, necessarily.

Q. If sensitizing current was to pass through T^{11}, would not the battery B^{11} have to be poled positively to the grid D in Fig. 2? A. The tube in Fig. 2 is not a detector tube.

Q. Isn't T^{11} a detector? A. T^{11} is a detector, yes. You are referring to sensitizing batteries for detectors.

Q. Yes, B^{11}. A. No, that was not always the case for the crystal detectors and such types. Sometimes the sensitizing batteries were used and sometimes they were not.

900 Q. You have already testified it was customary to use them. A. I misunderstood your question. I thought you were referring to vacuum tubes.

Q. Would you like to have the question read to you again? A. Yes.

(The question was read as follows):

Q. If sensitizing current was to pass through T^{11}, would not the battery B^{11} have to be poled positively to the grid D in Fig. 2? A. That is correct.

Q. Will you refer for a moment to the Von

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Lieben patent 1,038,910. Did not the Von Lieben tube operate by virtue of ionization of gas in the bulb? A. At this time is was not fully understood, those pure electronic discharges. Even Lowenstein speaks of ionization in his tube.

Q. Can you answer the question? A. I don't know. It depends upon how far the tube was evacuated.

Q. You were not familiar with Von Lieben tubes at that time? A. No, I never saw a Von Lieben tube.

902

Q. Do you know whether the Von Lieben tube as it was constructed at that time would work if the element which has been referred to as the control element H were not positive?

The Court: Is that H in Fig. 1?

Mr. Ashton: Yes, in all the figures.

A. If the tube was sufficiently evacuated it would work.

Q. You do not know whether they were sufficiently evacuated or not? A. I do not know.

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Q. You have no opinion as to whether they were or not? A. He has disclosed nothing in his patent to show whether they were or were not.

Mr. Ashton: I wish to point out, your Honor, the reference at the bottom of page 6 of Judge Winslow's opinion regarding the Von Lieben patent, where he states that the Von Lieben and Riesz patents are quite different from the Lowenstein disclosure and do not anticipate.

I also call your Honor's attention to

the statements of the Court of Appeals in the opinion in the Wallerstein case, beginning at page 5, with respect to this Von Lieben tube and patent. It goes on over to page 7, at about the middle.

Q. Is this not true of the Von Lieben tube: that the auxiliary electrode H constituted a partition in the tube and had necessarily to shut off the cross section of the tube? A. I believe he has shown it that way in the drawings.

905 Q. I call your attention also to page 1 of this Von Lieben patent, beginning at line 51, and ask you if that indicates anything to you as to the type of tube that the Von Lieben tube was, as to whether or not it would work if the element H were not positive? A. Yes, that shows that element H would have to be positive.

The Court: In order to do what?
The Witness: In order to operate.
The Court: As what?
The Witness: As an amplifier.

906 Q. In order for the tube to work at all it would have to be positive? A. Yes.

Q. Now, will you select the best reference with respect to the Mathes patent in suit 1,426,754? A. I believe that Arnold patent 1,129,942, is the best reference with regard to the claim that is in suit. That is tab No. 10.

Q. Are the resistances 14, Fig. 5, coupling resistances in the plate circuit? A. No. 14 is a resistance in series with the filaments.

Q. Are you sure of that? A. Well, he has numbered three resistances. Two of them are coupling resistances and one of them is a resistance in series with the filaments.

Q. Which resistance are you referring to as in series with the filaments? A. The one further to the right.

Q. Have you referred to the resistance to the left of the one marked 14? A. Yes, there are two resistances there that are coupling resistances.

Q. Do you know whether that is an error in the patent, as to marking that 14?

The Court: Which 14 are you speaking of? 908

Mr. Ashton: The one to the right.

The Court: The farthest to the right?

Mr. Ashton: At the extreme right.

The Court: In Fig. 5?

Mr. Ashton: Yes.

A. No, I do not know whether it is an error in the patent or not.

The Court: Do you mean the patent or the drawing, by your question? 909

Mr. Ashton: I mean the drawing, your Honor.

Q. Is the bias obtained by the batteries 11 in these figures?

The Court: Are you still referring to Fig. 5, or all of them?

Mr. Ashton: Most any one of them, your Honor. We will continue to refer to Fig. 5.

A. The bias is a resultant voltage of several voltages in the network.

Q. Will you refer to page 2 of the patent, line 109, where it states "the batteries 11 are preferably of such value as to make each of the grids 3,3 and 7 normally about 5 volts negative with respect to its adjacent filament"? A. Yes.

Q. Does that state what the function of the batteries 11 is? A. Yes, that is the function of the batteries.

Q. Is the battery 11 in Fig. 5 sometimes referred to as a bucking out battery? A. I be-
911 lieve so, yes.

Q. This is because it has to oppose the positive voltage of battery 13, which would otherwise be applied to the grid? A. It has to oppose that, but the drop of potential across 14 and the drop of potential across 5 also oppose it.

Q. Isn't the battery 11 chosen to make the grid 5 volts negative? A. It would make the resultant of the network 5 volts negative, yes.

Q. In Fig. 7 are not the tubes 2 all biased negatively by the battery 11 located just at the left of the middle tube? A. Yes. It is the same
912 layout as we had in Fig. 5 with respect to that particular tube.

Q. The drawing that you had with respect to these patents of Arnold 1,129,943 and 1,129,942, Exhibit G, have you a copy of that of your own, Mr. Cloud? A. I do not believe I have.

Q. We will use this together (handing witness). On this drawing the battery E6 is at the top, and necessary to buck out the effect of the battery E9 and also supply over and above that, of the value of the battery E9, the negative voltage for the grid? A. As I stated before, it makes the voltage of the complete network negative

voltage. In other words, you could not take batteries E9 and E6 and determine the negative potential from the two batteries alone. You have to take into consideration the drop of potentials through the resistances.

Q. Now refer to Colpitts patent 1,388,450. A. I have it.

Q. Is not the resistance 64 which you referred to the other day in the plate circuit? A. It is.

The Court: You are speaking of Fig. 2? 914
Mr. Ashton: Fig. 2.
The Witness: Starting from the positive side of generator 66, the plate circuit is through the primary of transformer 39, and it divides to the two plates of tubes 27 and 28 in parallel; thence through the space in the tubes to the filaments 33 and 34, down through the filament circuits.

By the Court:

Q. How do they get to 33 and 34? A. By means of the electron discharge. 915

Q. Do you mean across the plate; they go to the plate and then across to the filament, is that what you mean? A. Yes, you remember Mr. Waterman explained we generally spoke of them in that direction.

Q. Yes, but that is the way you get it to the filament—from the plate to the filament? A. Yes. Thence down the two sides of the filament to resistance 62, from the mid-tap point of 62 through resistance 64, and thence to the right, to the negative side of the generator 66, completing the circuit.

By Mr. Ashton:

Q. Did you mean to testify on Friday that this element 62 is a resistance? Is it not in fact an inductance? A. 62 can be either. It is drawn as a resistance. It can be drawn as an inductance as well. It works equally well whichever you use.

Q. Does the patent refer to it as an inductance? A. I do not know.

Q. You have not looked that up? A. I will do

917 so.

Q. Will you look at the bottom of page 2, the right hand column, beginning at line 126. Is it not referred to as an inductance? A. Inductance 62. I stand corrected.

Q. The current through this inductance 62 and the resistance 64 comes from the plate supply generator 66? A. It does.

Q. I now ask you to direct your attention to the Arnold patent in suit 1,329,283, the Power Circuit Patent. Will you select for me the best reference against this patent? A. It is a little

918 hard to decide between the patents, but I believe Arnold 1,129,943, tab No. 11.

Q. Is that your selection? A. That is my opinion.

Q. I ask you to direct your attention to the fine mesh of the grid in Fig. 1 of the patent in suit 1,329,283, and the coarse mesh grid in Fig. 3. Fig. 1 is a high voltage tube and Fig. 3 is a power tube? A. I believe that is the way that he has designated it in here.

Q. And this tube Plaintiffs' Exhibit No. 16 typifies the close mesh of Fig. 1, does it not (handing witness)? A. Yes, although Fig. 1 is exaggerated with respect to the spacing.

Q. Plaintiffs' Exhibit No. 12 with the wide mesh of the grid typifies Fig. 3, does it not (handing witness)? A. In Fig. 3 it is very difficult to say whether it is close spacing or wide spacing, as far as the grid is concerned.

Q. You do not know whether it is or not? A. I do not deny that it typifies the coarse spacing, but Fig. 3 does not show a coarse spacing.

Q. Isn't it so described in the patent? A. It is so described in the patent, but it does not show it in Fig. 3. 920

Q. You agree with Mr. Waterman's statements, I believe you testified on Friday, with respect to the spacing that you have just referred to, of these tubes? A. With respect to what?

Q. With respect to the spacing of the elements in the coarse and fine mesh of the grid.

Mr. Darby: I object to the question as indefinite.

The Court: Direct the witness to the statement that you mean.

Mr. Ashton: I understood him to say 921 that he agreed with these fundamentals that Mr. Waterman referred to in his testimony, and I am just asking him if that is the case. That is as I understood his testimony when Mr. Darby started in examining him the other day, and I just wanted to make sure that that is correct.

By the Court:

Q. Are you able to identify the testimony of Mr. Waterman, to which the question applies? A. Yes, sir.

Q. Then you can answer the question, can't you? A. The question asked me was relative to the effect of the spacing of the grid with regard to the filament on the output impedance of the tube. My statement was that the spacing of the grid from the filament had no direct relation to the output impedance of the tube.

By Mr. Ashton:

923 Q. That is your testimony, is it? A. I agree with Mr. Waterman in that statement.

Q. And do you agree with him as to the effect of the coarseness or fineness of the mesh of the grid? A. Oh, yes.

Mr Ashton: I call your Honor's attention to the fact that the date of application of the patent in suit according to the plaintiffs' position, will be taken back to the same day as the application for patent 1,129,943, which the witness has selected as the best reference against this patent in suit.

924

The Court: The date of application is May 28, 1914.

Mr. Ashton: Yes. The original application for the Arnold patent in suit 1,329,283 is also May 28, 1914, one application being differently numbered from the other.

Mr. Darby: I notice that Mr. Ashton has been calling attention to points that might be of assistance to your Honor as they are raised in connection with these various patents, and I think I might do likewise.

Mr. Ashton: It is helpful sometimes to

have them at the point in the record where the thing is likely to be under consideration.

Mr. Darby: Because of the fact it might be helpful I made no point when Mr. Ashton has done it, and I just want to call this to your Honor's attention, and with the same purpose in mind. One of the issues, as your Honor has undoubtedly grasped, is going to be, what is the effect of the filing date of an application which 926 states that it is a continuation of another earlier filed application; likewise, what is the effect of the filing date of an application which is a division of an earlier filed application, where that division has been filed a number of years after the original application?

The Court: I suppose that you mean, Mr. Darby, you are going to give me authorities right in point, so it won't take any time to clear that point up?

Mr. Darby: Yes, sir; and I will give them 927 to you now if your Honor wants them.

Q. Arnold patent in suit 1,349,252, the Straight Line Characteristic Patent. Will you please select your preferred reference to it? A. I have here again Arnold 1,129,943, as perhaps the best teaching. That is tab No. 11.

Q. I believe you will concede, won't you, Mr. Cloud, that it is desirable to have a straight line output from an audio amplifier? A. Oh, yes.

Q. You have stated that, haven't you, in your patent 1,907,741? A. Yes.

Q. If you will look at Fig. 4 of the Arnold

patent in suit 1,349,252, it is also desirable, is it not, to have as much of the straight operating range to the left of the vertical line in that curve? A. It is.

Q. As Mr. Waterman testified in connection with this patent? A. Yes.

Q. And it is desirable in the output of defendant's amplifiers A-41, A-36 and PA-39 to have a straight line output, is it not? A. Yes.

Q. Will you look at this Arnold patent 1,129,-
929 943, which you have selected. Are not the resistances 8 in both figures of this patent coupling resistances? A. They are.

Q. Do you find any disclosure as to the resistance of the tubes in this patent? A. There is no direct relation I can see of the resistance of the tube, although it speaks of a large number of audions in parallel, at page 2, starting at the top:

> "Hence for successful operation into a line of low impedance, for example, 500
> 930 ohms, a large number of audions in parallel would be required to provide in their common output line 11 an impedance approximately equal to the impedance line to which direct connection is to be made."

Q. If these tubes were high voltage tubes, might not their resistance be as high as several hundred thousand ohms—the A-C resistance? A. It is possible.

Q. Will you refer quickly to Colpitts 1,137,384. This shows a modulating tube, doesn't it?

The Court: That is tab No. 13.

A. Yes.

Q. Would not a modulating tube fail to modulate if it had a straight line output characteristic? A. It would.

Q. What is required for modulation is a curve characteristic just as in the case of a detector, isn't it? A. Yes.

Q. In other words, it is necessary to deform the outgoing current in order to impose the voice upon it, isn't it? A. Correct. That is with regard to the radio frequency. 932

Q. Yes. A. Not the audio.

Q. Would not the unidentified resistance in a modulator be harmful if it was of such magnitude as to produce a straight line characteristic? A. Which resistance are you referring to, 26?

Q. The one that is not given any number; I believe the one that you have referred to as 22. A. That resistance would not refer to the radio frequency characteristics.

Q. Is that resistance referred to or described in the specification? A. I don't believe it is.

Q. I think that is the case. A. An adjustable 933 resistance 26, line 40—starting with line 30, where it says the arrangement is also different, in battery 16—

Q. I asked about the one up here, the one that hasn't any number on top of Fig. 2. A. No, that is not referred to.

Q. Will you look at Kendall Patent No. 1,330,471. I believe you referred to resistance 80 in condenser 81 in Fig. 4, did you not? A. I did.

Q. Is this not merely a parallel feed resistance? A. Yes, it is a parallel feed resistance.

Q. Only in the event that it was relatively small, could it have any effect in the output cir-

cuit? A. You are speaking from a distortion point of view?

Q. Yes. A. Well, it has some effect, whatever its value is. It would have more use if it were low resistance.

Q. And is that parallel feed resistance always made very high, and so is entirely or without substantial effect? A. Necessarily, yes.

Q. Is the resistance 80 in the AC output circuit? A. Well, it is in the DC supply circuit.

935 Q. You haven't answered my question. A. It is a portion of the AC circuit but it is not in the AC output circuit.

Q. It is not? A. No.

Q. Is the tube 33 functioning as a detector? I call your attention to page 3, line 8.

The Court: Will you read that question?

(Question read.)

A. Yes, it is functioning as a detector.

Q. Will you now look at the De Forest Patent 1,375,447; is not in Fig. 1, No. 13, a reactance

936 serving as a coupler whose value is not in any way indicated? A. Yes, it is an inductance reactance.

Q. The same is true of Fig. 2 whose coils are 16? A. It is transformer 16.

Q. Referring to Fig. 5, is it not true that the only loudspeakers available at the time of this application were telephones supplied with horns? A. Yes.

Q. Did not ordinary telephones, that is commercial telephones, have very low resistance and impedance? A. Not as useful loudspeakers.

Q. Were they used in 1913 for loudspeakers? A. I rather presume they were.

Q. You don't know? A. My reason being that Lowenstein speaks of a receiver with many convolutions being necessary to work directly into the tube.

Q. You don't know yourself? A. Personally I do not know.

Q. Does the patent make any disclosure as to the impedance of either the loudspeakers or the tube? A. I don't believe that is there.

Q. Now, Weagant Patent No. 1,384,108, does the resistance 15 in Fig. 1 have any substantial 938
effect of increasing the AC impedance of the output circuit? A. It depends entirely on the capacity of the adjustable condenser 16.

Q. Is it not stated on page 1, line 90, that the resistance 15 is not necessary to the operation of the device? A. Yes. He says he prefers to include it, but it is not necessary.

Q. Now, take Hewitt Patent No. 1,393,369, were the use of resistances and inductances common in mercury devices for the purposes of stabilization? A. Yes.

Q. And the resistances 19 and 20, in Fig. 2 939
would have the same purpose, would they not? A. I do not believe that he has disclosed that this Fig. 2 is a mercury device.

Q. Don't you understand it to be such from its appearance? A. No, I don't.

Q. What kind of device do you think it is? A. It appears to me to be an electronic device.

Q. You don't know? A. I don't know.

Q. When the specification states, page 2, lines 19 to 25, that the filament acts as a negative to receive positive current, the patentee is referring, is he not, to the operation of the tube in the

ionized or gas conduction state? A. Not necessarily.

Q. You don't so understand him? Is that the reason the inductance 19 and the resistance 20 are both necessary to maintain the stability of the current? A. It may have been.

Q. Tell me why the grid 16 is enclosed in glass? Doesn't this show that the tube operates by gaseous ionization? A. He states, starting with line 7, "The perforate terminal wire forming the grid might be covered with a coating of glass, preferably thin or other suitable insulating material."

Q. You need the insulation, do you? A. Not necessarily. In other words you could create an electric field with the grid covered with glass in a pure electron device.

Q. You have done that, have you? A. I have done essentially the same thing.

Q. Have you done that? A. I have had the grid outside the tube.

Q. That isn't what you said. A. No.

Q. Now, take up Patent 1,403,475, the Arnold patent for the resistance capacity coupling and select the best reference against that. A. Fig. 6 of Patent No. 1,129,942.

Q. That is the same Arnold patent you referred to before? A. Yes.

The Court: That is tab 10?

The Witness: Yes.

Q. Now, in defendant's circuit, it is desirable, is not, to have as little distortion as possible in the circuit, from the photo-electric cell to the input of the first tube? A. Yes.

Q. You refer to which inductance in Fig. 6 of this Patent No. 1,129,942? A. That is the coupling between the first and second stage or the second and third inductance 17, condenser 18 and resistance 14.

Q. Now, will you take up the Arnold Patent 1,448,550 and state the best reference in regard to it? A. I believe Van Der Bijl No. 1,350,752, tab No. 23.

Mr. Ashton: I call your Honor's attention to the fact that the application date of this Van Der Bijl patent as well as the other ones relied upon by the defendant are all later than the effective which we have proved for this patent in suit. 944

Mr. Darby: You mean what you seek to prove. I do not want to accept that statement.

The Court: Which he asserts he has proved.

Q. Now, patent in suit 1,465,332, select the best reference to it, this being the Common Plate Supply Patent. A. That is Patent No. 1,129,942, which is tab No. 10 again in this case. 945

Q. Now, as a practical man in this radio and amplifier art, it is important, is it not, Mr. Cloud to keep the AC in the second tube from getting back into the input of that tube through the battery? A. Yes, it is important in any case to keep the AC current out of the DC.

Q. Now, we refer to the Campbell Patent 1,227,113 which you referred to as to the Common Plate Supply Patent; can you state the filter theory of this patent, or is it a big job?

A. Well, I believe I can perhaps, by referring to some notes.

The Court: Is that the one Mr. Darby wanted me to read at my convenience?

Mr. Ashton: Yes, your Honor. This is known as the Campbell filter, isn't it?

The Witness: Yes.

Q. That is used so widely? A. Yes. There are four types of Campbell filter: Low pass,
947 where it passes all the frequencies below a certain frequency; high pass, where it holds back all the frequencies below a certain frequency and passes all above that frequency; the band pass, whereby it passes frequencies between given low frequency and a given high frequency; and band elimination filter where the filter rejects certain frequencies and allows all other frequencies to pass below and above that frequency. In this particular case involved in this suit, there is what is called a low pass filter. Then again we can sub-divide each one of these
948 filters to ladder or bridge types.

Q. Have you been looking this up during the week-end, Mr. Cloud? A. Oh, I have worked on filters for years.

Q. I was just wondering whether you were preparing a lecture on it or whether you wanted to go through this from the point of view of your side of the case.

Mr. Darby: This is cross examination, Mr. Ashton, and he was answering your question.

Mr. Ashton: If you wish him to continue—

Mr. Darby: I don't.

The Witness: I was prepared the other day, but I did not want to go into it in detail, because we were rushing through the case.

Q. I refer you to the Alexanderson Patent No. 1,340,101; are not the tubes shown in this patent four-element tubes? A. Yes.

Q. Are they not variable impedance tubes? A. There is nothing to indicate that they are variable impedance tubes by the drawing. 950

Q. Do you know whether they are or not as disclosed in the patent? A. No, I do not.

Q. I believe you testified the other day that the plate supply is from the generator 1. A. Yes.

Q. You meant from the battery 16, did you not? A. Yes, I should have said battery 16. Generator 1 also super-imposes on that supply for transmitting—no, I am wrong about that. It is from the battery 16.

Q. Now, Patent No. 1,520,994, the Gain Control Patent; which is the best reference as to that? 951

The Court: I guess we can agree that lines 19 and 18 the word there should be "amplifier" not "implifier"; I am not sure that the word "implifier" isn't the more appropriate.

Mr. Ashton: I will concede that, your Honor. I had not noticed that.

The Witness: We can use Van Der Bijl 1,350,752, tab No. 23.

Q. Is that the same one that you selected for the other patent? A. Yes, for the resistances.

Mr. Ashton: I also call your Honor's attention to the fact that it is the plaintiffs' position that the date of this patent goes back to 1914 at least.

Q. As a practical man in this art, Mr. Cloud, it is very useful in installing talking motion picture systems, is it not, to be able to make an adjustment by means of the gain control such as the gain control of the Arnold patent? A. Yes.

953 Q. And you can adjust it for particular devices, can you, as to the amount of gain which you may need? A. Yes, that is the manner in which it is used.

Q. Do you recall Mr. Kendall's testimony with regard to trying to accomplish an improved result prior to March, 1914, by adjusting the B supply? A. Yes.

Q. Would you prefer the gain control to that method? A. Yes, I would.

(Discussion off the record.)

954 Mr. Darby: You don't want the Court to be under the impression that the B supply affects the filament, do you?

Mr. Ashton: You may deal with it as you please.

The Court: Is there a distinction between the B supply and B battery? I thought your opening statement was that the B battery supplied the filament, however, I may be misquoting you in that.

Mr. Ashton: No, it is the A battery that heats the filament; it is the B battery that furnishes the plate current and the C battery put the potential on the grid.

Mr. Darby: I did not think you wanted the Court to be under a misapprehension.
Mr. Ashton: No.

Q. Now, refer if you will, Mr. Cloud, to this Arnold Patent No. 1,448,550 in suit, which you have cited against the Patent 1,520,994; it seemed to me that you had some difficulty in recalling when you were first familiar with potentiometers this morning, and I don't think you stated when you first knew of the use of 956
the potentiometer in connection with the three-element vacuum tube of the audion type. A. Well, I will say it was around 1915 or 1916.

Mr. Ashton: I call your Honor's attention again that the date of this patent in suit is much earlier than that.

Q. You did not mean to suggest that the resistance in the Johnson Patent 1,432,865 which you referred to was a gain control potentiometer such as shown in the Arnold patent, did 957
you? A. No, I did not mean to suggest that that was the gain control.

Re-direct Examination by Mr. Darby:

Q. Mr. Cloud, in discussing the Straight Line Characteristic Patent in cross examination you made the statement that the load resistance in the output circuit had no effect, or no appreciable effect, on the characteristic curve of the high frequency currents. Is that correct? A. That is correct.

Q. Did it have effect on the characteristic

curve of the low frequency currents? A. It did.

Q. And what effect did it have? A. It would result in a mismatch if too low, and would distort the low frequency characteristics.

Q. In other words, when the output circuit has both high frequency currents and low frequency currents, is it just as essential to keep the low frequency currents undistorted as it is where the output circuit has just low frequency
959 currents? A. It is just as essential.

Mr. Ashton: With reference to what prior patent was that, Mr. Darby, may I ask?

Mr. Darby: I do not recall which one it was, but it is a fundamental proposition.

The Witness: With reference to the modulation.

Q. Likewise in discussing the Kendall patent
960 1,330,471 you referred to the vacuum tube circuit in the middle of the arrangement in the centre of the page, as being a detector. What other function does the vacuum tube in that circuit serve? A. Detection is accompanied with amplification in the usual arrangement of detectors, using the vacuum tube for detection.

Q. Do I understand that it is both the detector and amplifier? A. It is.

Q. You also testified on cross examination that inductance and capacity are used whenever alternating current and direct currents are employed, and it is desirable to keep the effects thereof separate. How long have inductances

bridged by condensers or their capacities been used for that purpose to your knowledge? A. Since 1905.

Q. Is that arrangement something that is commonly employed in telephone service? A. Yes, it is commonly employed in common battery exchanges to keep the voice currents out of the common battery supply that supplies all of the telephone instruments. The particular application I have in mind is in the operators' sets on a common battery exchange, where they 962
employ a choke and condenser for that purpose.

Q. And how long in the commercial field have you been familiar with the employment of that arrangement for that purpose? A. Since 1905.

Q. In your cross examination you stated that certain equipment—and I do not recall what equipment it was at this moment—was not used for talking motion pictures but only in connection with incidental music. Will you please briefly explain what you mean by that statement? A. The equipment that I manufactured 963
and was engaged in manufacturing at that time used phonograph records which were amplified and reproduced in loud speakers for incidental music in motion picture theatres.

Q. What I am concerned with is what is the technical meaning of incidental music in the talking motion picture field? A. Well in the old day they used a pipe organ which arranged special music to accompany the picture, without the talking, and this arrangement was arranged to play the proper musical accompaniment to a picture, using phonograph records for that purpose.

Q. So instead of having the spoken action they

merely had music to accompany the visual exhibition; is that right? A. Yes.

Q. I believe you likewise stated that your office is next door to the office of General Talking Pictures. Do you mean you are in the same building? A. No, we are in adjoining buildings. They are at 217, I believe, and we are at 220.

Re-cross Examination by Mr. Ashton:

965 Q. In your patent 1,907,741 that you referred to this morning, you were relying in 1930 upon the special construction of a transformer, were you not? A. That was a portion of the patent.

The Court: Is this re-cross?

Mr. Ashton: Yes.

The Court: Has this to do with matters brought out on the re-direct?

Mr. Ashton: Yes, it has specifically to do with that.

966 Q. And you were also relying upon the resistance 9 in the input circuit of Fig. 1?

Mr. Darby: Which patent are you referring to?

Mr. Ashton: This patent 1,907,741.

Mr. Darby: Will you be more definite in your question? What do you mean by "relying"?

Mr. Ashton: I mean that that is part of the disclosure—the arrangement of that resistance.

A. That was not part of the patent.

Q. It was not any part of it? A. It was not claimed as part of the patent. We disclaimed the use of the resistance shunted—

Q. Wasn't it claimed in combination with the condenser C, as shunting the condenser C? A. We disclaimed that particular arrangement of condenser shunted with a resistance. It may be a part in combination with other things.

Q. What is meant in Claim 15 when it says, "said means comprising a capacity device in said circuit"? 968

Mr. Darby: I object, if your Honor please.

Mr. Ashton: Mr. Darby brought out in his cross examination, your Honor, that impedances and condensers and things of that sort were used a long time ago. This witness is actually claiming in 1930 arrangements of those things, and that is the reason for my ex mination.

The Court: Are those two statements inconsistent?

Mr. Ashton: Mr. Darby's re-direct examination was to give your Honor the implication that these elements that we have been talking about here— 969

The Court: Inductance and capacity.

Mr. Ashton: Yes—were very old things. The witness himself is claiming them as elements in this patent which he applied for in 1930.

Mr. Darby: Even so, I do not see that.

The Court: Let us have the evidence.

Q. What were you referring to in that Claim 15, by "said means comprising a capacity de-

vice in said circuit"? A. We are not claiming the capacity enters into the thing. Capacity and inductance and resistance are primeval or primary elements, and they may be recombined in many ways to form patents.

Q. Even in 1930? A. Even in 1940.

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971 Mr. Darby: If the Court please, that concludes the patent side of this case, and from now on we will confine ourselves expressly to the law side.

On the law side, if I may take a moment to crystallize what the evidence thus far has established, by stipulation or undisputed evidence thus far the facts are that the defendant's apparatus before the Court under charge of infringement was manufactured by The American Transformer Company and sold to the defendant. The American Transformer Com-

972 pany was licensed under each of the patents in suit, by virtue of a license set up that started with cross-license arrangements between the General Electric Company and the Radio Corporation of America and the American Telephone and Telegraph Company, by a document which granted a license to The American Transformer Company, which license was joined in by the American Telephone and Telegraph Company, and that the apparatus before the Court under charge of infringement was manufactured by the American Transformer Company under that license.

That license was limited by express language in the license agreement to a certain use. The apparatus was sold to us with that limited license of use, in accordance with the express terms of the American Transformer license, noticed right on the instrument itself.

That takes care of the apparatus itself, so that it raises a square issue here, about which there is no contention as I understand it, that if the American Transformer 974
Company had sold this apparatus to somebody, to us for example, and we had used it in connection with radio receiving sets for receiving broadcast news and music, there would be no question but that was perfectly legal and within the license. And there is likewise no question that that same apparatus could be used and in fact was so used for that purpose—that is, apparatus similar to it in every respect. That takes care of the circuit apparatus, the chassis or whatever you want to call it. 975
The apparatus is absolutely of no utility as sold without tubes.

This original set-up between the General Electric Company, American Telephone and Telegraph Company, Radio Corporation of America and the remainder of the parties entering into that patent pool also included the patents for tubes, and under that set-up until about 1929, the late Fall of 1929, the only licensed manufacturer of radio tubes under this group of patents at least, was the Radio Corporation of America. The Radio Corporation of America

was not a licensed manufacturer. Let me correct that. The arrangement was that the Radio Corporation of America was the sole selling agent of the Westinghouse Company and the General Electric Company—the Westinghouse Company manufacturing 40 per cent. of the requirements of the Radio Corporation and the General Electric Company manufacturing 60 per cent. of its requirements.

977 At that time, prior to the Fall of 1929, there was another source of supply of vacuum tubes, known as the Cunningham tube. The Cunningham tube was manufactured by either the Westinghouse Company or the General Electric Company and allowed to be sold by the Cunningham Company under the name "Cunningham," although they were really a Radio Corporation or Westinghouse Electric tube. They were sold in competition with the ordinary Radio Corporation tube, although
978 they were virtually the same.

In the Fall of 1929, the Radio Corporation started to grant licenses under the vacuum tube patents. That was after the anti-trust suit in Delaware. Their first licensee was the Raytheon Company, a company located right outside of Boston. The second licensee likewise about ten days or two weeks after granting the Raytheon license was known as the National Union Radio Company, which was a corporation composed of three or four of the plaintiffs in the Delaware anti-trust litigation. From that time on, the Radio

Corporation have granted licenses to a number of tube manufacturers.

The licenses granted to the tube manufacturers likewise were restricted as to use, and the license contracts likewise provided that the tubes should be marked, or the cartons containing the tubes should be marked with approved language carrying with them as they were sold, this restriction notice.

It is agreed between us that the various 980
notices which were incorporated with respect to tubes either on the carton or in literature enclosed in the carton with the tube, were of the following form. With respect to the RCA:

"LICENSE NOTICE.

"In connection with devices it sells, Radio Corporation of America has rights under patents having claims (a) on the devices themselves and (b) on combina- 981
tion of the devices with other devices or elements, as for example in various circuits and hook-ups.

"The sale of this device carries a license under the patent claims of (a), but only for (1) talking machine uses, (2) radio amateur uses, (3) rad experimental uses and (4) radio broadcast reception; and only where no business features are involved.

"The sale does not carry a license under patent claims of (b), except only (1) for legitimate renewals and repairs in appa-

ratus and systems already licensed for use under such patent claims on combinations, (2) for assembling by amateurs and experimenters, and not by others, with other licensed parts or devices, or with parts or devices made by themselves, but only for their own amateur and experimental radio uses where no business features are involved, and not for sale to or for use by others, and (3) for use with licensed talking machines and licensed radio broadcast receiving devices; and only where no business features are involved.

983 "This device is licensed for no other use unless, by special written contract of sale with Radio Corporation of America, the purchaser has agreed to use it in some other special manner only, as set forth in the contract of sale. The right to employ the device in such special manner is non-transferable except by special agreement with Radio Corporation of America."

984 The license notice with the Cunningham tubes—

Mr. Ashton: I wish to say, Mr. Darby, as to your reference to these other notices, the Cunningham, I believe you have in mind, and referring to the Raytheon notice, I have no objection to agreeing that these notices have been used, but I would like you to prove that you have purchased tubes from these concerns.

Mr. Darby: We will.

Mr. Ashton: Before the filing of the bill of complaint.

Mr. Darby: So far as the Raytheon is concerned, we did not purchase those tubes before the filing of the bill of complaint, because the Raytheon Company was not in business before the filing of the bill of complaint.

Mr. Ashton: The license was dated March 19, 1929, and the bill was filed in September of the same year.

Mr. Darby: All right. As to the Cunningham license, I shall not take the time 986
to read it, but will ask the stenographer to spread it on the minutes. It is substantially that of the Radio Corporation of America, except that it does not contain the last two sentences, but substitutes therefor this statement:

"Manufactured and sold under rights, patents, and inventions owned and/or controlled by Radio Corporation of America.".

The Court: Does that mean that the entire last paragraph of the license notice 987
which you have already read, does not appear in the Cunningham license?

Mr. Darby: That is correct, your Honor.

The Court: That last paragraph consists of two sentences.

Mr. Darby: That is right, your Honor, and substituted for that last paragraph was the statement that I have just read.

(The Cunningham license is as follows):

"LICENSE NOTICE.

"The sale of this device carries a license under patent claims on the device

itself but only for (1) talking machine uses, (2) radio amateur uses, (3) radio experimental uses and (4) radio broadcast reception; and only where no business features are involved.

"The sale does not carry a license under patent claims on combinations of the device with other devices or elements, as for example in various circuits and hook-ups, except only (1) for legitimate renewals
989 and repairs in apparatus and systems already licensed for use under such patent claims on combinations, (2) for assembling by amateurs and experimenters, and not by others, with other licensed parts or devices, or with parts or devices made by themselves, but only for their own amateur and experimental radio uses where no business features are involved, and not for sale to or for use by others, and (3) for use with licensed talking machines and licensed radio broadcast receiving devices;
990 and only where no business features are involved.

"Manufactured and sold under rights, patents and inventions owned and/or controlled by Radio Corporation of America."

Mr. Darby: The license notice on the Raytheon tubes, and this is comparatively a recent tube, and I have no doubt in the world but what this particular license notice was subsequent to the license to the Raytheon Company.

Mr. Ashton: It is in the agreement itself.

Mr. Darby: It is? Where is it?

Mr. Ashton: Right here (indicating).

Will you read it from the agreement, Mr. Darby?

Mr. Darby: Yes, I will. The license attached to the Raytheon tubes, in any of the manners I have already indicated, provided that the license which is dated March 19, 1929,—it is earlier than I thought it was, it is as follows:

"LICENCE NOTICE.

"This device is licensed under patent 992
claims of Radio Corporation of America on the device itself but only for use in radio broadcast reception and reproduction of sound and pictures from records, to be heard or seen in the immediate vicinity of the apparatus used in such reproduction (not including transmission to, or reception at, other points of such sound and pictures), and in each case only for private use in homes for educational and entertainment purposes. It is not licensed under patent claims on combinations of 993
the device with other devices or elements, as for example in various circuits and hook-ups, except only for use in apparatus and systems already licensed for use under such patent claims on combinations."

And in connection with the Raytheon Company, it is customary to print that license notice on the tab of the carton on which the vacuum tube is sold.

The Court: Is there any question that the form of notice as printed on the carton is the same as that right in the agreement.

Mr. Aston: No, there is not, your Honor.

Mr. Darby: I might state my point in putting in the Raytheon notice is to show, in connection with the Raytheon, beginning at that time, they began to expand the license use to which the tube might be put, and I am going to argue rather strenuously, if the plaintiffs' theory is sound, they could carry that to a point where it would demonstrate far more effectively perhaps than I can, the unsoundness of it.

995 It is likewise stipulated that the following is a complete list of the licensees under the patents in suit as well as the date of the licenses granted and the date of expiration thereof, which licenses were the same in so far as this case is concerned with the license that was granted to the American Transformer Company. Is that correctly stated?

Mr. Ashton: I think so, subject to check. No doubt it is so.

996 Mr. Darby: I am accepting your statement that it is correct and I might note, if your Honor please, that there are 51 licensees in all and the licenses begin as early as—

Mr. Ashton: All about the same date.

Mr. Darby: Here is one that is dated February 1, 1927.

Mr. Ashton: Which is the date of the American Transformer license.

Mr. Darby: It is, yes. That was the General Radio Company, though.

May this be copied into the record?

The Court: Yes, copy that in the record in full.

POWER SUPPLY LICENSES EVER ISSUED

Name of Company	*Date of Licenses*	*Date of Expiration*	*Assignment*
Air-Chrome Studios, Inc	7/1/29	8/1/31	
Air American Mohawk Corp.		8/1/31	Assigned from Mohawk Corp. of Illinois 6/4/28
American Transformer Co.	2/1/27	8/1/31	
Autorad Electric Corp.	5/31/28	8/1/31	
Bremer Tally Mfg. Co.	7/19/27	8/1/31	998
Buckingham Radio Corp. (Ill. Corp.)	1/1/29		Assigned to Buckingham Radio Corp. (Del. Corp.) 5/31/29
Buckingham Radio Corp. (Del. Corp.)		10/7/29	Assigned from Buckingham Radio Corp. (Ill. Corp.) 5/31/29
Consolidated Radio Corp.	8/21/27		Assigned to United Reproducers Corp. 4/17/29
Crosley Radio Corp.	7/15/27	8/1/31	
H. H. Eby Mfg. Co.	5/2/28	8/1/31	
Electrad, Inc.	4/12/29	8/1/31	
Electrical Research Lab. Inc.	7/1/28	2/27/31	999
Enterprise Mfg. Co. of Pa.	11/17/27	8/1/31	
Farrand Mfg. Co., Inc.	2/1/27	8/1/31	
Ferranti, Inc.	11/1/28	8/1/31	
Federal Tel. Mfg. Co.	6/10/27		Assigned to Acoustic Products Co. (later called Sonora Products Corp. of America) 6/29/29
General Amplifier Co.		8/1/31	Assigned from Martin Copeland Co. 5/15/29
General Household Utilities Co. formerly U. S. Radio & Television		8/1/31	Assigned from U. S. Electric Corporation 1/1/29
General Industries Co.	8/19/29	8/1/31	

1000 *Case.*

Name of Company	*Date of Licenses*	*Date of Expiration*	*Assignment*
General Radio Co.	2/1/27	8/1/31	
Gilfillan Bros., Inc.	7/1/27	8/1/31	
A. R. Goodwin (doing business under Chelsea Radio Co.)	9/21/27	7/1/28	
Gray Products, Inc.	3/22/29	8/1/31	
A. H. Grebe & Co., Inc.	8/1/27	8/1/31	
Grigsby-Grunow Co.		8/1/31	Assigned from Pfanstiehl Radio Co. 4/15/28
1001			
Howard Radio Company	6/10/27	8/1/31	
King Manufacturing Corp.	6/1/27	1/1/31	
Kingston Products Corp.	5/2/28	8/1/31	
Kolster Radio Corp. (formerly Federal Brandes)	8/1/27	2/6/30	
Martin Copeland Company	2/1/27		Assigned to General Amplifier Co. 5/15/29
Mowhawk Corp. of Illinois	6/14/27		Assigned to All American Mohawk Corp. 6/4/28
Wm. J. Murdock Co.	6/28/27		Assigned to Philadelphia Storage Battery Co. 2/10/28
1002			
National Co., Inc.	2/1/27	8/1/33	
Pfanstiehl Radio Co.	8/1/27		Assigned to Grigsby-Grunow Co. 4/15/28
Philadelphia Storage Battery Co.		8/1/31	Assigned from Wm. J. Murdock Co. 2/10/28
Harold J. Power, Inc.	6/27/27	12/1/28	
Radiart Lab., Inc.	5/3/29	8/1/31	
Radio Receptor Co., Inc.	2/1/27	8/1/31	
Sonora Products Corp. of Am. (formerly Acoustic Pro. Co.)		10/3/30	Assigned from Federal Tel. Mfg. Co. 7/29/29 to Acoustic Products Co.
Splitdorf Radio Corp.	4/25/28	8/1/31	

Name of Company	*Date of Licenses*	*Date of Expiration*	*Assignment*
Steinite Radio Co. (Kansas Corp.)	2/1/27		Assigned to Steinite Co. (Delaware Corp.) 3/6/28
Steinite Mfg. Co. (formerly The Steinite Co.)		8/1/31	Assigned from Steinite Radio Company 3/6/28
Sterling Mfg. Company	2/1/27	8/1/31	
Stewart-Warner Corp. (formerly Stewart-Warner Speedometer Corporation)	8/1/27	8/1/31	
Stromberg-Carlson Tel. Mfg. Co.	5/1/27	8/1/31	
Temple Corporation	12/1/28	2/6/30	
Thordarson Electric Mfg. Co.	1/1/29	8/1/31	
U. S. Timmons, Inc.	2/1/27	8/1/31	
United Reproducers Corp.		10/3/30	Assigned from Consolidated Radio Corp. 4/17/29
United States Electric Corp.	8/1/27		Assigned to U. S. Radio & Television Corp. (now General Household Utilities Co.) 1/1/29
Zenith Radio Corporation	2/1/27	8/1/31."	

1004

1005

Mr. Darby: Now, with the Court's permission I will turn over this phase of the case to my associate.

Mr. Berliner: May it please the Court, before I proceed with the witnesses, at the opening of the defense, there were certain documents marked A, B, C and D.

Mr. Ashton: The first agreement that you offered was A. We have no loose copy of it, and a copy will have to be prepared. However, it is in the Independent record which we will have identified similarly to

the way the Lowenstein record was identified.

Mr. Darby: I will assume the burden of making copies of what you have not spare copies of.

Mr. Ashton: We have the other agreements.

Mr. Darby: The 1926 agreement?

Mr. Ashton: Yes; also agreement B between General Electric and American Tele-
1007 phone and Telegraph; the next is General Electric and American Telephone and Telegraph Company and Radio Corporation of American and Western Electric Company and also the 1926 agreement.

The Court: For the purpose of clarity, can we refer to them by their exhibit letters?

Mr. Ashton: I think so.

The Court: Suppose you call the missing one A; is that the first in point of time?

1008 Mr. Darby: Yes, your Honor. That is the one I will make a copy of. The date of that is November 20, 1919.

The Court: And the parties?

Mr. Darby: General Electric Company and Radio Corporation of America.

Mr. Ashton: The parties are the Marconi Company.

Mr. Darby: No, it is General Electric Company and Radio Corporation of America.

The Court: That is Defendant's Exhibit A. Now, Exhibit B is what?

Mr. Darby: Exhibit B is the General

Electric Company and American Telephone and Telegraph Company agreement that is dated July 1, 1920.

The Court: You have a copy of that, have you?

Mr. Ashton: Yes. I was misinformed, when these copies were handed me. This 1919 agreement is in these extra binders we have, so it can be marked right now.

(Marked Defendant's Exhibits A and B respectively.) 1010

Mr. Darby: Exhibit C is the General Electric-American Telephone and Telegraph and Radio Corporation of America and Western Electric Company contract dated July 1, 1920.

(Marked Defendant's Exhibit C.)

Mr. Darby: We have the 1926 agreement.

The Court: What is the exact date?

Mr. Ashton: July 1, 1926.

The Court: What parties?

Mr. Darby: General Electric Company 1011 and American Telephone and Telegraph Company.

CHARLES L. LOUGHEAD, called as a witness on behalf of the defendant, having been duly sworn, testified as follows:

Direct Examination by Mr. Berliner:

At the present time, I have no occupation. My residence is East Orange. I know the Amer-

ican Transformer Company of Newark, New Jersey. I was president from about the middle of June, 1929, to about the 1st of March last year and was in active charge of its operations. It is the company mentioned in the testimony here and was engaged while I was with it in the manufacture of transformers, amplifiers, and sound equipment of various kinds and things allied with the transformer business. It was under the RCA license which has been marked
1013 Defendant's Exhibit E.

Mr. Schermerhorn of the American Transformer is vice-president in charge of manufacturing and engineering. Mr. Zeloney has been a manufacturer's agent representing them in the sale and disposition of amplifiers.

I know General Talking Pictures Corporation, the defendant in this suit and also know Mr. Schlesinger of that company. I first met him about the 1st of July, 1929,—I don't know whether that is the exact time or whether it was before that. I may have seen him more than
1014 once just before that time, I am not certain. I was asked to go over to meet his brother who was here from South Africa, and Mr. Schlesinger and his brother wanted to discuss the purchase from us of quite a number of amplifiers, I presume for talking pictures, although I don't remember when it was.

The Court: If you don't remember, just tell us; don't tell us what you presume.

I think that was my first discussion; I am not sure that there were two. Mr. Schlesinger wanted to know, if I remember, our facilities

for manufacturing and our ability to supply a considerable quantity of amplifiers and as to our license and the terms under which we could sell them. I don't remember whether the question was asked or not whether we were paying royalties. I met him at the office of the General Talking Pictures Corporation at Times Square. As a result of that conversation with him, this letter was prepared, and mailed or delivered to General Talking Pictures Corporation.

Mr. Berliner: I offer that letter in evidence.

(Marked Defendant's Exhibit J.)

The Court: Let me look at it a minute.

(Document handed to the Court.)

After this letter which is dated July 16, 1929, I or my company had occasion to write a second letter to General Talking Pictures Corporation. I think they asked for some change in the original letter,—I don't think the change was with respect to any option. The second, which you hand me, is a letter from American Transformer Company to General Talking Pictures Corporation, dated July 24, 1929. I signed both letters.

Mr. Berliner: I offer that letter in evidence.

(Marked Defendant's Exhibit K.)

The representative of Western Electric mentioned in the letter of July 16 is Mr. H. E. Young. He is here in court. I think his title was general commercial engineer with the Western Electric; but I am not sure. I could not be

at all definite as to how long before the writing of this letter of July 16, Exhibit J, I had conversations with Mr. Young. It was later than the 15th of June. I cannot give a definite conversation, but can give the substance of one conversation, which I cannot be certain is the one referred to here. We were not talking about this matter at all, but in the course of the conversation the matter or subject matter of General Talking Pictures with Mr. Schles-
1019 inger came up in some way. I cannot remember which way the conversation came up, but at any rate one of us said, "Well, at any rate do you think the General Talking Pictures would go out of business if we did not sell them amplifiers?" And we both agreed they would not. He raised no objection to our proposed selling of amplifiers to General Talking Pictures Corporation. We had been selling them to General Talking Pictures Corporation before July, 1929, and since February, 1929, approximately—I do not know the original date. But no objection
1020 was raised by him.

At that time, prior to the writing of the July 16th letter, I may have received report from Mr. Zelony, the manufacturer's agent, whom I mentioned before with respect to General Talking Pictures Corporation, but I don't know. He was there frequently and we talked. I cannot say as to that. I don't remember that he had spoken to me that he had had talks with the Western Electric representatives.

The fifth paragraph of the letter of July 16th states that I was informed that a representative of the Western Electric examined one of these amplifiers which we had installed in a theatre

and as to that particular amplifier he stated that it appeared to be very high grade product. I do not at this moment recollect who that representative was. It was to someone in our organization.

Before writing these two letters and sending them to General Talking Pictures Corporation I took them up, or the subject matter of them with the board of directors of my company. I think both letters. They approved the sending of those letters. I also consulted with our counsel Mr. Charles Lum of Newark, of Lum, Tamblyn & Colyer and submitted to him the subject matter of these letters before they were sent. He approved sending them. 1022

Q. You knew, did you not, from the dates of those letters down to the time you finished your work with the company that General Talking Pictures Corporation was engaged in supplying talking motion picture equipment to theatres. A. Well, I cannot say that I knew it from having seen them; but I had no doubt.

Q. You mean you had not seen them in theatres? A. Never saw them in theatres. I cannot tell you how I knew it, but I knew they were. 1023

My company sent reports regularly to the Radio Corporation of America, under our license. With respect to the amplifiers sold I think they were quarterly reports and were required to be sent under the license agreement with a royalty statement and check attached for seven and a half per cent. per equipment. My company first began to include in these royalty statements the name General Talking Pictures Corporation as a purchaser of these amplifiers about the 1st of December, 1929. I was not

there at the time. I was sick. I was away for three months—four months—five months. Before that no names had been furnished. The license did not require it.

Q. It is a fact, then, that the names began to be furnished from December, 1929, on, at the request of the Radio Corporation of America? A. I don't know. They requested, that is all I know.

From December, 1929, to the expiration of our
1025 license, I believe in August, 1931, these quarterly statements with the name General Talking Pictures Corporation mentioned thereon, were regularly sent to the R. C. A. whenever we sold them any.

Our largest customer for amplifiers during the period 1929, to August, 1931, was General Talking Pictures.

Mr. Berliner: I offer in evidence a complete list of the statements—they have been stipulated—commencing with the one
1026 forwarded July, 1929, the first covering the quarter commencing April, 1929. The period covered is April, 1929, though the report was forwarded in July.

Mr. Ashton: Although we have no specific objection to the reports, your Honor, as to their proof and so on, I wish to note on the record that the suit was actually brought on September 6, 1929. The first report giving the names of customers was on December 7, 1929.

Mr. Berliner: It covers the period to July, 31, 1931.

The Court: You say the suit was brought in September, 1929?

Mr. Berliner: 1929. From that list furnished by Mr. Ashton I have excluded one letter which refers to checks I have no knowledge of. I do not think he cares about it. It is dated October 28th.

(List marked Defendant's Exhibit L.)

I thing we sold our amplifiers to others for use in talking picture reproduction, outside of 1028
General Talking Pictures Corporation, but I don't know. We had occasional customers. I don't know that they were used for that, though we offered them for sale for that purpose.

I think that with each royalty statement, or approximately the time the royalty statement was sent, a check for royalties was forwarded by our company to the Radio Corporation of America.

From the time that the company commenced giving the names of General Talking Pictures Corporation and other users of amplifiers for 1029
talking pictures, in December, 1929, for a period of approximately one year thereafter, that is until December, 1930, those royalty checks were sent to and accepted by the Radio Corporation of America, as far as I know. No protest was made on their part until that period.

No notice was ever sent to us objecting to such procedure or business on our part. I had occasion during that period to confer at times with representatives of the Radio Corporation of America from December, 1929 to December, 1930—one year;—well, about that period, from the date of the first royalty statement on which

the names appeared. Not to my recollection, at any of those conferences, did they in any wise object to our sale of these amplifiers to General Talking Pictures Corporation. The first protest that we received was in December, 1930. Thereafter, we continued to send them royalty statements, I think, mentioning General Talking Pictures Corporation. I have not seen them. They are on that list. And accompanying those statements were checks of the company, for the roy-
1031 alties.

The license to the American Transformer Company which is here in evidence was never cancelled. It expired by its own limitation. As a matter of fact I had discussions with the Radio Corporation representatives and Western Electric representatives with a view to extending the license. Such a license was in course of preparation with Electrical Research Products, but not with the Radio Corporation.

This paper which you show me was printed, before I was with the company, but I recognize
1032 it as something that the American Transformer Company had issued. I think I have seen it.

Mr. Berliner: Showing that he offered these transformers for sale for theatre purposes.

Mr. Ashton: What is the date on it?

Mr. Berliner: 1928.

Mr. Ashton: I do not see that it has any bearing, your Honor.

Mr. Berliner: I offer it not by way of constituting an admission against the plaintiffs, but by way of acquiescence, that is all.

The Court: A man cannot acquiesce in anything that he does not know about.

Mr. Berliner: The witness will testify they were circularized, all over.

The Court: They might have been circularized and the plaintiffs not know about it.

Mr. Berliner: That is so, but may I ask some preliminary questions about it?

The Court: Maybe Mr. Ashton will admit it. 1034

Mr. Ashton: I object to it, your Honor. In the first place, Mr. Loughead said he was not there when this circular was put out, and I do not see how he can testify to it.

Mr. Berliner: I have a man here to testify to it, but it is simply a question of saving time. If that is your only objection I will put a man on to testify to it.

The Court: Then, the offer is withdrawn at this time.

The Witness: To my knowledge American Transformer Company issued catalogues and circulars advertising amplifiers. 1035

Mr. Ashton: I object to this line of examination, your Honor, on the ground that the suit was brought before these things had taken place, and it does not seem to me that they can have any possible bearing as an estoppel or anything else.

The Court: I would not be disposed to argue that with you, but the testimony thus far, if I understand it, is that during the year 1930, which would be the year following the suit, this American Trans-

former Company sold its device to this defendant, reported that fact to the plaintiff and paid the plaintiff a royalty based upon such sales.

Mr. Ashton: It will appear that all those royalties were refunded as soon as practicable after they were discovered.

The Court: I am merely speaking of the evidence to date.

Mr. Ashton: You see with that additional fact it will appear that they really have no bearing at all.

1037

The Court: These circulars, you mean?

Mr. Berliner: Whether they were refunded or not is immaterial as a question of law.

Mr. Ashton: Perhaps more important, your Honor, is also the fact that any royalties were not paid to the plaintiff anyway.

Mr. Berliner: They were paid under the license agreement to the R. C. A.

1038

The Court: Under the guise of discussing catalogues and such things don't let us get into anything else. I simply say that is the state of the record at this time.

Mr. Ashton: I object to the line of examination, including that to which the last question was directed, upon the ground that it cannot have any bearing on the question of estoppel or license after the suit has been pending for some time.

The Court: I suppose his idea is that it may go to the plaintiffs' knowledge of the nature of the business of the licensee.

Mr. Berliner: Right.

The Court: I suppose that is the purpose of it.

Mr. Ashton: But you see the suit had already been brought long before this took place.

The Court: The suit was brought in September, 1929, which was the ninth month of the year. I will let him show what the company did, with the hope that he will connect it, and if he cannot I will entertain a motion to strike out. 1040

The Witness: The company issued circulars and catalogues regularly as part of its business advertising amplifiers. Well, I cannot testify from personal knowledge. I did not send out any, as far as I know, but I do know that they were sent out.

Q. Do you know to whom they were sent out, generally?

Mr. Ashton: That is pretty remote, your Honor, now. If he knows that they were sent out? 1041

Mr. Berliner: I will connect it in a moment.

Mr. Ashton: I think he is going very far afield, if we get into these details.

The Court: I realize that possibility, but as a practical matter a president of a company might know, and he might, for instance, buy lists of customers. We know such things are done. He may be leading to that; I do not know.

Mr. Ashton: I would like to know what the point is.

Mr. Berliner: Knowledge on the part of the plaintiffs.

Mr. Ashton: Are you suggesting that we received them; is that the point?

Mr. Berliner: Yes, that you had knowledge of them. That you received them.

Mr. Ashton: You might ask the witness that.

Mr. Berliner: I would if you had not objected.

1043 The Witness: I don't know whether we had the electrical companies on our mailing list. We advertised in trade journals.

Q. I show you "Electronics" of October, 1930. Look at page 22. Is that your advertisement (handing to witness)?

Mr. Ashton: That is a long time after the suit was brought, your Honor.

The Court: Yes.

Mr. Berliner: It involves knowledge, your Honor.

1044 The Court: They began suit eleven months before this.

Mr. Berliner: On the good faith of this suit, this suit has been pending for over five years.

The Court: I think I will exclude an advertisement of October, 1930.

Mr. Berliner: May I have an exception.

The Court: Yes.

The Witness: The catalogue you show me now was issued by my company. I cannot give any definite date on this.

Mr. Berliner: If I may refresh the wit-

ness' recollection, this refers to 1930. "During the year 1930, panels for more than 1,000 systems were supplied." This must have been issued in 1931.

Mr. Ashton: I object to it for the same reasons, your Honor.

The Court: Same ruling.

Mr. Berliner: Exception.

The Witness: During the period that I was president of the company, I do not remember 1046 that my company sold any amplifiers to the Western Electric Company, just by itself. The Western Electric Company was a customer of our company and I have no doubt it was on our mailing list, but I don't know.

Mr. Ashton: I will move to strike that question out also, your Honor, later, if that is directed to bringing in the circulars that we were talking about before.

The Witness: Our company was never sued 1047 by any of the plaintiffs in this action or by the R. C. A. for a violation of this license agreement and was not sued by them or any of them for any reason that I know of.

Cross Examination by Mr. Ashton:

I joined the American Transformer Company about the middle of June, '29, just about a month before I signed this first letter, Exhibit J, which is dated July 16th. I do not know if the original of the paper you show me is in court. I don't know if the paper you now show me is the original. I have not read this thing through since

the date of it, four and a half years ago. Well, I would assume it is the original. I don't know. I cannot say whose handwriting it is in the upper right hand corner. It is not mine.

Mr. Ashton: It states that this memorandum was prepared by M. Schlesinger, but not authorized to be sent by the American Transformer Company.

The Witness: As far as I know Mr. Schlesinger was president of General Talking Pictures
1049 Company. I think this draft was submitted after I had talked to him and his brother in his office, but it is not clear in my mind. However, I think that is correct. That is my best recollection. I do not remember this letter in my files and I do not know that it came from the files of the American Transformer. Assuming that I am correct in thinking that this conversation which I had with Mr. Schlesinger was prior to July 3, 1929, the date of this memorandum; that is the only thing I have to date it.

1050 I took this draft of the letter up or the letter I wrote with our attorney, Mr. Lum. I am not certain as to whether this was taken up with him first or not.

The paper you now hand me and which you say is a proposed letter dated July 16, 1929, is the same as Exhibit J. It is quite a lot to read through.

By the Court:

Q. By looking at the paper that you have just seen, dated July 16, 1929, are you able to say where that paper was typewritten? Is there anything on the paper that suggests to you where

it was actually typewritten? A. The word "pictures" in the address that appears at the top of the first sheet looks somewhat like my writing. That is as near as I could come to it. That might be mine, although I don't always write the same.

By Mr. Ashton:

I never said that I know of this yellow-pencil memorandum attached to these other papers I have been looking at. It is not my writing and 1052
do not know whose writing it is. I cannot say that I have any idea whose writing it is. This writing in the upper left hand corner of the paper you are showing me, the letter of July 10, 1926, is not my writing and I have no idea whose writing that is.

In my conversation with Mr. Schlesinger I don't remember discussing with him the preparation of such a letter as Exhibit J.

Q. But you recall now, do you not, that this draft of July 3, 1929, was probably submitted to you by Mr. Schlesinger? A. Yes, I think so. 1053
I could not account for it in any other way.

Q. You could not account for it in any other way? A. Oh, by Mr. Schlesinger?

Q. Yes. A. Oh, not by Mr. Schlesinger. I do not know who submitted it, but that is evidently a draft on which my first letter was written.

By the Court:

Q. The word "that" is not clear. What do you mean, that that is a draft of something? A. This is dated prior to my letter.

Q. What do you mean by "this"? "This" and

"that" do not mean anything. A. This draft of July 3rd I undoubtedly had before me when I wrote my letter of July 16th. The coincidence is too great.

By Mr. Ashton:

Q. There is no doubt about that, is there, Mr. Loughead? A. I would think it is true.

Q. I want to get this very clear. You seem to
1055 have remembered some of these things pretty well. Really, isn't it true that this draft of letter and my conversation and so on were all pretty well thought out? A. No, sir; I cannot agree with you. It may have been, but I don't remember that it was.

Q. I would like you to tell me exactly how this letter happened to be sent over to you. A. I did not remember how the—

Mr. Berliner: I object to the statement "happened to be sent over to you." It
1056 was not sent over to him.

Mr. Ashton: He says it was submitted to him.

Mr. Berliner: That is not testimony, and I move to strike it out.

The Court: I think that objection is sound. Reframe your question.

The Witness: I cannot tell you how the proposed letter of July 3, 1929, got into the files of our company. I said that my letter of July 16, 1929, Exhibit J, and the one of July 24th, Exhibit K are based on it because the phraseology is the same in several paragraphs. I don't

think the phraseology in this letter is mine. Well, I saw it in your office. That is the first time I saw it. I don't think I am the author of that letter. I am sure I am not the author.

Q. If you were not, was anybody else in your company as far as you are able to know— A. No, I am quite sure there was no one else in our company. I do not know who the author was.

Mr. Ashton: I am asking the witness to state the difference between the two letters of July 16th and 24th, as compared with this draft here. There are no material differences in the two letters of July 16th and 24th so far as the plaintiffs are concerned. 1058

The Witness: I have not seen this in four years and a half, and it is a little hard.

Q. I wish you would read it, Mr. Loughead, to yourself. A. May I have the letter of the 16th?

The Court: Yes, here it is (handing witness). 1059

The Court: The difficulty that you are laboring with, of course, is that you have not this proposed letter of July 3rd either marked for identification or in evidence. That is your point, isn't it?

Mr. Ashton: Of course I shall offer it later on. I ask that the letter of July 3, 1929, be marked for identification Plaintiffs' Exhibit 29.

(Marked Plaintiffs' Exhibit 29 for Identification.)

1060 Q. You have the question in mind, have you? A. The question is what the differences are?

Q. Yes. A. In the first paragraph we did not state that the Western Electric Company.

Mr. Berliner: Your Honor, I object for two reasons: in the first place the July 16th and 24th letters speak for themselves and are in evidence; in the second place the draft certainly is not admissible,

1061 not because it is marked for identification but because it refers to antecedent negotiations which were finally embodied in a consummated agreement, and it cannot be argued that prior negotiations are admissible in evidence to show what the subsequent conclusion of those negotiations really amounted to. The draft is conceded to be a draft.

Mr. Ashton: The point is that Mr. Loughead would not send out this letter the way it was submitted to him, and we want

1062 to show—

The Court: The fact is that he did not send it.

Mr. Ashton: But the draft. The point is that he had not seen the original draft the way it is submitted. That is the reason for the questions and the comparison. I am going to ask him when he points out the difference why he left that out.

Mr. Berliner: It is not admissible in evidence, your Honor.

The Court: That is argumentative. It is perfectly plausible that the spoor of the letter writer may be disclosed in Exhibit

29 for Identification. The consideration of one dollar, and so on, that never originated in the mind of the layman, you know.

The Witness: I do not recollect why I did not state in the letter of July 16th or in the letter of July 24th that "we manufacture such amplifiers without infringing any patents of any kind whatever in the United States," except that I would never write such a thing for anybody. Neither would the Western Electric Company. 1064

Mr. Ashton: I want to know why he left out these two or three things.

The Court: Yes, you want to know why he left out certain things, and I do not see how you can really get that in any comprehensive form unless you read the contents of the letter, and I am not going to let you do that—read that into the record. It is quite clear that the letter sent was not the letter as drafted. Can't you go on from that point? 1065

Mr. Ashton: With your Honor's leave I would like to ask the witness why he did not make this particular statement that is at the end of that first paragraph of the letter.

The Court: I want to suggest to you, without participating too much in your case, that the only way you can do it is to ask, why didn't you make any statement covering so and so.

Q. Why didn't you make the statement that they, referring to the Western Electric Com-

pany, have examined one of the amplifiers which—

The Court: I will ask you, Mr. Ashton, to adhere to my ruling.

Mr. Ashton: I am sorry, I imagine I do not understand your Honor.

The Court: You may ask the witness, why didn't you make any statement covering such and such a general subject. You

1067 may not quote from this paper.

The Witness: I did not make a statement in the letter that representatives of the Western Electric Company had examined one of our American Transformer amplifiers and had made no objection to it, because I could not make it of my own knowledge.

Mr. Berliner: Is that question directed to the draft?

Mr. Ashton: Yes.

1068 Mr. Berliner: If so, I object to it.

The Court: It is directed to a subject and not to the letter at all.

Mr. Berliner: Mr. Ashton did mention the letter.

The Court: The answer is that he did not mention the subject in Paragraph 5 of Exhibit J.

The Witness: Paragraph 5.

That statement does not appear in the letter of July 16, 1929, Exhibit J; I said we have been informed, I think, as I remember reading it just now. That is the difference. Because I was in-

formed, and I cannot say definitely. I did not know it. This paragraph 5 of Exhibit J, the letter of July 16, 1929, does not appear in the letter of July 24, 1929, Exhibit K. I don't know why I left that out. It is my recollection that this letter of July 24, 1929, Exhibit K, was supposed to take the place of the letter of July 16th, but what I remember is this other. My final arrangement was this one of July 24, 1929.

Q. You stated I believe that when you talked with Mr. Young of the Western Electric Company you were talking about something else. A. Yes, sir. 1070

Q. Other than the question of supplying amplifiers. Is that right? A. No, not the question of supplying amplifiers, but something different from the matter of General Talking Pictures.

Q. Yes. A. No, I was talking about supplying amplifiers.

Q. You were trying to get the right to supply them; is that it? A. Objecting to the fact that we had to compete with about three hundred people who had no licenses and we were paying 1071 a license fee.

This recent license which I said that my company was negotiating to get from the Western Electric Company has to do with phonograph music reproduction, and does not include talking motion pictures. I don't think it specifically includes it. I don't remember that it expressly excludes them, but very likely. I am not quite sure about that.

Mr. Berliner: Mr. Ashton is testifying as to what the proposed license agreement includes or excludes. I think that is improper.

The Court: I think he has a right to ask him on cross examination.

Mr. Berliner: I do not object to his asking him, but I don't want Mr. Ashton to do the testifying; that is for the witness.

The Court: I think that Mr. Ashton merely wants to clarify the situation.

The Witness: The Mr. Young I mentioned, is
1073 Mr. Harry E. Young, connected with the company. He was the commercial engineer. I don't know if he was an officer of the Western Electric Company. In 1929 I brought to the attention of General Talking Pictures Corporation, the license agreement which we had with the Radio Corporation and which is Exhibit E in this case. I called attention to the provisions of that license relating to restriction of the right to manufacture and sell.

Mr. Berliner: Your Honor, he is giving
1074 the questions and answers, without giving the witness a chance to answer, and I object to that line of questions, and I ask that the question be stricken out.

The Court: Well, both counsel have been doing that right along. Tell me, Mr. Ashton, what did you mean by your question, "You brought the license agreement to the attention of the General Talking Pictures Corporation"; that is not clear to me.

Mr. Ashton: I am trying to find out, your Honor, if at the time of these conversations which the witness has referred

to between the president of the General Talking Pictures Company and himself, whether or not Mr. Loughead actually brought the license agreement, the written license agreement to the attention of Mr. Schlesinger.

The Court: Did you mean to ask him whether he showed the agreement or whether he talked to him?

Mr. Ashton: Maybe both, your Honor.

The Court: Ask him, that is what I 1076
want to find out.

I did not show Mr. Schlesinger the license agreement, but I did give him the terms of it in a general way, and we talked and discussed the restrictions and limitations.

By the Court:

I told him we could sell with that license plate on stating what those restrictions were and I told him what the restrictions were. I cannot 1077
say whether I told him that from any memorandum I looked at or from what I recalled of the language of the license. I think before that came, there was a letter sent to him which gave that.

By Mr. Ashton:

At that time I knew the provisions of the license very well.

The Court: You mentioned incidentally, what might be an important fact, namely,

that Mr. Schlesinger was the president of the company; is that the fact?

Mr. Berliner: That is the fact.

The Court: And was the fact in July, 1929?

Mr. Berliner: Yes, and in 1929.

The Court: I am glad to know it.

The Witness: This, which you hand me, is a license plate of the type which we placed upon the amplifiers which we sold.

1079

Mr. Ashton: I ask that the license plate be marked for identification as Plaintiffs' Exhibit 30.

Mr. Darby: Let us look at it; maybe you can put it right in evidence; we have no objection to its being offered in evidence if you want to offer it.

Mr. Ashton: I will offer it when we come to it.

(Marked Plaintiffs' Exhibit No. 30 for identification.)

1080 The Witness: The photostat you show me appears to show a panel of audio amplifiers manufactured by my company. I am not an engineer, so I cannot be certain of this. It has a name plate on it, as far as I can tell, it has. These notices are placed conspicuously on the amplifier. I cannot say whether on the back of the amplifier.

Mr. Ashton: I offer the photostat referred to by the witness for identification as Plaintiffs' Exhibit 31.

(Marked Plaintiffs' Exhibit No. 31 for identification.)

The Witness: I do not know whether my company received a letter dated November 17, 1928, signed by General Talking Pictures Corporation addressed to the American Transformer Company. I was not there at the time; I have no way of knowing. I have some recollection of seeing such a letter in the files, but I could not identify it. I have not seen it recently. I have seen the letter signed American Transformer Company, dated November 23, 1928, addressed to General Talking Motion Pictures, which is at- 1082
tached. I do not know whether that letter was sent or by whom. I can tell by the initials who dictated it. This was six months before I arrived on the scene.

Mr. Ashton: I ask that the first letter referred to, dated November 17, 1928, by General Talking Pictures Company to the American Transformer Company be marked for identification.

(Marked Plaintiffs' Exhibit No. 32 for identification.)

Mr. Ashton: And the letter of Novem- 1083
ber 23, 1928, from American Transformer Company to General Talking Pictures.

(Marked Plaintiffs' Exhibit No. 33 for identification.)

The Witness: I remained active with the company until from about the middle of June, 1929, until about the 1st of November, 1932. From the time I became president of the company until the license from the Radio Corporation expired I was active, except for my health, except that I was away for a period of three or four months. I was away when the company was asked to sup-

ply the list of customers to whom we had sold amplifiers.

Q. Do you remember the facts as to the refund of royalties by the Radio Corporation for amplifiers which they found you had sold outside the scope of the license, after you sent them the first list of licensees on December 7, 1929? A. Yes, sir, I was there then.

Q. And you received refunds, did you not?

1085 Mr. Berliner: I object to that question, because refunding of royalties for any reason whatsoever, certainly is not binding on the purchasers of the amplifiers and licensees.

The Court: I cannot pass on the weight of the evidence until I know what the evidence is.

Mr. Berliner: They asked if they got refunds.

The Court: You proved that payments were made for making certain sales by licensees and I think it is equally competent
1086 for the other side to prove what happened to those payments, for what it is worth. It may not be worth anything, but I would like to know the facts.

Q. You know, do you not, that refunds were made for all amplifiers that were sold outside the scope of the licenses? A. I know that refunds were made for what the RCA said were sold outside the scope of the licenses.

The Court: Give us the dates, Mr. Ashton.

Mr. Ashton: Do you want me to go through all the dates on all of these?

1087

The Court: Why don't you gentlemen go and make the schedules of the refunds and put it in tomorrow?

Mr. Ashton: It is all in the binder, your Honor, that we have here, and which was offered in evidence.

Mr. Berliner: Not in that binder; I did not offer that in evidence.

Mr. Ashton: The royalty reports are all in this Exhibit L, and there are several letters in addition; those and some checks 1088
which show exactly what the refunds were and when they were made, and I can read them off in a few minutes, either now or tomorrow morning. It will probably save time if I do it tomorrow morning.

The Court: I think you gentlemen can agree upon it.

Mr. Darby: There is no dispute about it, but Mr. Ashton is laboring under a misapprehension when he says that they are included in this exhibit. They are not.

Mr. Berliner: There is a schedule of re- 1089
funds. There is no dispute as to the fact, but we object to the relevancy and admissibility of it.

Mr. Ashton: We will offer it tomorrow, your Honor. That will simplify it.

The Witness: In making these refunds, the Radio Corporation selected the names of the talking picture people that appeared on that list.

The Court: And only those?

Mr. Ashton: And only those, the others being obviously proper sales for amateur radio purposes.

Mr. Berliner: May I enter an objection to that statement by Mr. Ashton? If he submits his schedules, I do not object to them as factual evidence, but I do object to their admissibility.

The Court: Perhaps you do not realize that I asked the question whether the refunds referred only to those particular accounts, and he said yes.

Mr. Berliner: There is nothing in the
1091 schedules which cover that in that language and that is the reason I rose to object.

Mr. Berliner: The first refund referred to is the check of the RCA and is dated December 9, 1930, of which I have a photostat here, served by the plaintiffs themselves.

Q. Can you tell me, Mr. Loughead, what is the earliest date that you received any word from the Radio Corporation of America as to your
1092 sales outside of the scope of the license? What is your best recollection of the date that you first heard of their objection? A. I have no recollection of anything prior to the letter accompanying the checks.

Q. Are you sure about that? A. I am sure I have no recollection, yes, sir.

Q. You have no recollection. You don't remember receiving calls from Mr. Anderson of the Radio Corporation? A. I do not think he ever called on me in Newark.

Q. Or telephone messages? A. I don't remember that. I saw him in New York, but I never saw him in Newark.

1093

Re-direct Examination by Mr. Berliner:

The Court: Then, these details about the refunds you gentlemen can agree on?

Mr. Berliner: I have them here as submitted to me by Mr. Ashton. They are absolutely correct factually; I just enter my objection to their admissibility.

Mr. Ashton: I will offer them in the morning as our exhibits.

1094

Q. Mr. Loughead, when you stated to Mr. Ashton on cross examination that you talked to Mr. Young and that you did not go to see him about General Talking Pictures, is it not a fact, nevertheless, that you did talk to him about General Talking Pictures Corporation? A. Yes.

Q. And your sale of amplifiers to the company? A. Yes, sir.

Q. And he did not object? A. Yes, sir.

Before sending the letters of July 16th, July 24th, 1929, I think I did tell Mr. Schlesinger, at the conferences with him, that I had a right to sell his company those amplifiers.

1095

From June, 1929, when I came to the American Transformer Company until I left the company in 1932, my company was bidding with other licensees of the RCA in the same field for the manufacture and sale of amplifiers.

Q. And were those other companies offering amplifiers for theatre reproduction purposes as well as in the open market?

Mr. Ashton: I don't think it makes much difference what other companies were offering.

The Court: Are you objecting, Mr. Ashton?

Mr. Ashton: Yes, sir.

The Court: Please state your objection.

Mr. Ashton: What other manufacturers of amplifiers were offering for sale, seems to have no bearing on what this company was offering for sale or as to any other matter in the case.

Mr. Berliner: Certainly it has a bear-
1097 ing as to the course of practice and procedure of which plaintiffs had knowledge and RCA had knowledge, that the whole market was selling—

Mr. Ashton: It could have no bearing on this case—

The Court: I will agree with you if you give me a chance to rule. I will sustain your objection.

Mr. Berliner: Exception.

The Court: Now, to save time, don't waste much time on the talk with Mr.
1098 Young and no objection being made, because I regard that as quite an indefinite conversation.

Mr. Ashton: Yes, your Honor.

MAX A. SCHLESINGER, called as a witness on behalf of the Defendant, being first duly sworn, testified as follows:

Direct Examination by Mr. Berliner:

I reside at the Savoy-Plaza Hotel, New York City. I am a lawyer by profession, but in recent

years have devoted my time exclusively to commercial enterprises. I have been president of the defendant General Talking Pictures Corporation since its organization in September of 1928.

The business of that corporation is the leasing of recording and reproducing equipment for talking motion pictures to theatres in the United States. I came to organize this corporation in that I was interested in theatres and the amusement business generally, and saw the change from the silent picture to the talking picture, 1100 and was acquainted with a man by the name of Dr. Lee De Forest, who was then operating a company called the De Forest Phonofilm Corporation, engaged in the manufacture and leasing of recording equipment for talking motion pictures, and for reproducing equipment in the same field.

I saw exhibitions of the pictures produced by that company, in New York City, in about 1923. Between 1923 and 1924 and 1925. I believe the first one I saw was at the Rivoli Theatre, in New York. 1101

I organized the General Talking Pictures Corporation, and that company took over the De Forest Fonofilm Corporation. At the time I took it over it was the only one that had talking picture reproducing equipment installed in this country. They had installed about sixty or seventy equipments. At that time they had also produced and on hand talking motion picture films. A great many of them; yes, sir. They continued in operation down to the time General Talking Pictures Corporation took them over.

Before I organized General Talking Pictures Corporation in about September, 1928, I con-

sulted patent counsel, who was then acting for Dr. De Forest—Messrs. Darby & Darby, particularly Mr. Samuel E. Darby, Jr.—and had several conferences in connection with the talking picture business. I also discussed the question of the use of amplifiers manufactured by licensees of the Radio Corporation and had an opinion rendered by Mr. Darby on the subject before I organized General Talking Pictures Corporation.

This is a letter I received from Mr. Darby in
1103 connection with that subject matter.

Mr. Berliner: I offer it in evidence.

Mr. Ashton: I think, your Honor, that it is proper the witness should state that he consulted counsel. However, I do not think that counsel's opinion is proper evidence, and I therefore object to this opinion, which of course I have not read. The only possible bearing on the case as far as I can see is that Mr. Schlesinger claims that counsel told him to go ahead and
1104 make these amplifiers.

The Witness: Not make them.

Mr. Ashton: Well, purchase them.

Mr. Ashton: I do not see that the opinion really has any bearing on it at all, but simply that he was advised by counsel.

Mr. Berliner: May it please the Court, we do not offer it to prove as a legal fact, which is for your Honor, that he had a right to purchase them but that he was so advised; and under a decision of the Circuit Court of Appeals, for the Third Circuit, opinions of counsel in such matters are admissible.

The Court: For what purpose?

Mr. Berliner: To prove good faith, and that he acted in reliance on it and not with any malice or intention to infringe.

The Court in the Third Circuit stated that it also goes to the question of estoppel, because the argument there, as I recollect it, is that if counsel was consulted by the defendant alleged to infringe, it is likely that the same question must have been up before the plaintiffs, and the Court 1106
holds that such testimony as to advice is admissible,—not to prove the fact, but that he acted on the advice. The citation is 64 Fed. (2d) 185.

The Court: What did you mean by the expression "that fact, that something had been before the plaintiff?" That is what I want to know and what I find difficult to follow.

Mr. Berliner: I am merely paraphrasing what the Circuit Court of Appeals stated there,—that the advice was sought 1107
and taken by the defendant, is indicative of the fact, not proof, that the plaintiff itself must have considered this question and possibly have passed upon it. However, we need not go as far as that. It is purely on the good faith of the defendant in seeking advice before embarking on an enterprise relating to patents. We do not offer the letter as proof, as a question of law, because that is for your Honor to decide.

The Court: I would like to read Mr. Darby's opinion, but I do not think it is

1108 *Max A. Schlesinger—For Defendant—Direct.*

a competent part of your proof. I will sustain the objection, with exception.

By Mr. Berliner:

The Witness: I took up with Mr. Darby the matter of our right to purchase amplifiers manufactured by a licensee of the plaintiffs and the Radio Corporation of America. He advised me that the equipment manufactured legally under
1109 a license can be bought by me, if sold in the open market, and I can disregard any restrictive notices on the equipment itself, and use it for any purpose I desired. That conversation was had and that advice was given about in August of 1928, about a month before I organized the company.

After I organized the company and before February 4, 1929, I used amplifiers for talking picture reproduction purposes manufactured by the American Transformer Company. In the gubernatorial campaign of 1928, shortly after
1110 I organized the company, Governor Smith was the only candidate for Governor who could have talking pictures publicly in the streets of New York. A novelty was presented in talking pictures for the candidate in the public streets, and the Republican authorities came to me and said they could not get any talking pictures because Governor Smith had them all tied up, so I made a picture of the candidate, Mr. Ottinger, and a speech by him and had it go on a truck through the City of New York, using the American Transformer amplifier. I bought that amplifier from a company called the Phototone Company, who, in turn, had acquired it from the

American Transformer Company. I acquired several other amplifiers from the Phototone Company before that period. It was early in the stage of talking pictures, as now known. There were not as many theatres equipped with them as now.

Before I organized the defendant company, De Forest Fonofilm Corporation, its predecessor, was the only company that had installed talking motion picture apparatus in theatres throughout the country, in the sound on film system, as distinguished from sound on disc.

Before February, 1929, I had several conversations with representatives of the plaintiffs. I talked to Mr. Otterson, who was then, I think, vice-president of the Western Electric Company. This was in 1927, at his office, 195 Broadway, I believe that is the address of the American Tel. & Tel., and I met Mr. Drake at that place. I understood he was second to Mr. Otterson, for the purpose of my interview with him.

I had several talks with both Mr. Otterson and Mr. Drake again after I organized the General Talking Motion Pictures Corporation. We had several negotiations proposed, one in connection with talking motion picture equipment for foreign countries and others for talking motion pictures for South Africa generally, besides foreign; thirdly, a proposal to merge the patent situation that they contended they might have, as against those that I contended I had in the motion picture field. Dr. De Forest has from the inception been connected and still is connected with my company. We talked about the motion picture business in America and the probability and desirability of having motion picture pro-

ducers of silent pictures undertake to go into the new field. We talked about my entering into the field, and after I had entered into the field, I again talked to them and told them how I progressed in it. I told them the equipment I was developing and my proposal to lease them, buy the goods in the open market and assemble them and then lease them to the theatres, and they asked me, "What are you going to do about an amplifier?" I said "I would like to buy them
1115 from you."

They said that was rather a question; that they were using theirs for their own purposes; that the theatres were making a great demand for equipment; that they could not get the equipment fast enough for the growing industry, and I told them I had in 1928, around the campaign, obtained one of their licensed amplifiers, and I could get a supply of them.

I am just trying to recollect the incidents, they came so fast and furious in those days, and it is so far back. I am trying to do the
1116 best I can. Well, particularly after my return from a European trip, and about the time that Mr. Knox, another of the officials of the Western Electric Company or Electrical Research Products Corporation was about leaving for England, Mr. Knox called on me at my office and we had a talk about the amplifier that I was using, and he said, "You are lucky to have a licensed amplifier." I told him I was getting it from the American Transformer Company. I told Mr. Otterson that I was getting it from the American Transformer Company. He said to me, "We are more concerned with the true

reproduction obtained, so that the art is not impeded by the poor reproduction you get from bad sound."

By the Court:

Q. Excuse me for interrupting, but you will have to fix the time for this. A. That was in 1927, in the Fall of 1927, and again in 1929, on my return from Europe.

Q. Speaking of your conversation with Knox, 1118
was that again in 1929? A. That was with Otterson again in New York in 1929.

By Mr. Berliner:

I had a conversation with Mr. Otterson before I went to Europe in 1928 and discussed the amplifier that I was using in the campaign.

By the Court:

Q. What time was this in 1929, please? A. 1119
First I am talking of 1928, if your Honor please, in the campaign of 1928.

By Mr. Berliner:

That was in the Fall of 1928. In the Fall of 1928 I merely told Mr. Otterson that I was able to procure an American Transformer amplifier for the campaign, and was discussing with him the possibilities of the Western Electric selling me more amplifiers. He said that he had known of the good work of the American Transformer amplifiers; he thought the amplifiers, as reported to him, were good amplifiers; that it was

a licensed amplifier, from one of their licensees. He did not object to our purchasing and using it.

By the Court:

That conversation was not directed particularly to the campaign. We had discussed several subjects under consideration, as I outlined a few minutes ago. I am speaking now of the Fall of 1928. We discussed several matters.

1121 By Mr. Berliner:

We discussed the proposal of their company to sell equipment for theatres in South Africa, which I was to buy in America for the South African firm; also the possible exchange of licenses under patents owned by them and patents owned by me, and in addition to that, what I was doing in America with my American patents, the American De Forest patents.

Q. In the year 1929? A. In other words, I kept Mr. Otterson closely advised of what my company was doing, because we had it in mind that ultimately a connection would be arranged between the two companies.

1122

The Court: We are still in the Fall of 1928. You appreciate it is very important that you should state what was said and you should not characterize the nature of your interviews. As a lawyer, you must appreciate that.

The Witness: In the early part or between January and February of 1929, I met Mr. Otterson again in New York, this time at the uptown

office of the Electrical Research Products Corporation. I think in the Fisk Building, 57th Street, New York. No one else was present. There were several subjects up for discussion, among others—I told him that since I was back from London, I could get control of the German patent situation; that, together with the British patent situation which I controlled, and the American situation which I controlled, would call for a trade agreement, and I discussed also the possibility of a combination or purchase of 1124
my interest by them. He said that he was interested in anything along the progressive lines of business, and had made studies into our patent situation through his counsel and our counsel and deliberations were going on from time to time, but at this particular meeting at his office, he said, "Well, how are you getting along in your American business?" which he did from time to time, and particularly, on that occasion I remember I said, "I am getting along very well. Business is growing very fast, and I have struck a very fine amplifier. They are making it 1125
practically for me alone, as I understand it, my particular model, and other models of a similar kind they are making for a few others." He said, "Are you still having the American Transformer Company supply you?" And I said, "Yes," and I said, "That is a funny situation; as a competitor, I am paying you royalties out of my business," and we both laughed, and he said, "It's funny." I don't want to bind myself to the exact words, but that is substantially what happened.

In the early part of 1929, until about June or July of that year, I had been buying ampli-

fiers regularly for talking motion picture purposes from the American Transformer Company. I had been doing that on the advice I had received from our counsel Mr. Darby.

Q. Do you wish to add—was any further conversation had with Mr. Otterson or any representatives of his or the plaintiff companies before July, 1929? A. Merely that several representatives, such as Mr. Palmerton—

He is engaged in the company in some ca-
1127 acity of selling equipment for talking motion pictures. Mr. Gregg is the name of another man I met, who called on n.. and discussed the possibility of our buying equipment for talking motion pictures from them,—not amplifiers alone,—for South Africa, and while in my office, I said, "It is strange that I should be buying equipment from you for South Africa, and assembling equipment here for the American industry." Mr. Palmerton stayed there for quite a length of time discussing my American business, and naturally I discussed with him the salient fea-
1128 tures of the equipment, which is the sound head and the amplifier. I told him about the amplifier I was using. I told him I was buying them and paying a price that was far less than the price they were charging me for South Africa. I said the American Transformer Company was charging much less than they charged for Africa, and that the price for the equipment for South Africa was inconsistent with the price that I was getting from the American Transformer Company. There was a discussion of the price I was getting for export, and the price I was paying for the domestic market. I discussed that with Mr. Drake, Mr. Otterson, Mr. Palmerton, Mr.

Gregg and Mr. Knox. The result was that I was unable to purchase for foreign countries, because of their price.

By Mr. Ashton:

Q. I understood you to say that this was before July, 1929, can you be more definite than that? A. Yes. There was a time when Mr. Otterson went over to Europe, and it was after his return from Europe in 1930—let me get my 1130 dates fixed—after his return in 1929, we both had been there at separate times—will you let me refresh my recollection for a moment, because there were so many trips I made at that time.

By Mr. Berliner:

Q. Yes, just consider it a moment. A. Yes, there were several talks I had in February of 1929.

Q. If you cannot fix any particular month, just 1131 do the best you can, that is all. A. Well, fixing it by the time there were so many negotiations between the Western Electric, Radio Corporation, myself and the German Patent Control—they visited here and we visited abroad, and in the course of these deliberations we also discussed the prices of equipment, and we never did buy the equipment for South Africa.

Q. In other words, you do not remember what period of 1929 it was? A. I cannot give the exact dates in 1929. I travelled a great deal both here and abroad, and I did not have any diary.

Mr. Otterson told me that as long as the reproduction was not affected there was no ob-

jection to everybody going into the field, and wanted to keep bootleggers out who did not want to make machines that would reproduce honestly and accurately from the recordings of their licensees in motion pictures. All they could have talked about was the amplifiers.

Mr. Otterson told me that he had spent endless time and money in trying to educate the manufacturers of motion pictures in the silent field to enter upon the recording business in talk-
1133 ing pictures, and that he was particularly interested that people would use the amplifiers that would reproduce properly and accurately, and the American Transformer Company, he told me, was one of those who made a high-class amplifier. He did not object to it. On the contrary, he encouraged us to use it.

The Court: Instead of saying, "he encouraged us to use it," if you will say he stated thus and so you will help me.

The Witness: I would rather put it, if
1134 your Honor pleases, that I told him how I had engaged in the pineapple industry, which is foreign to this, and that it was a new industry in South Africa, and that when I attempted to find out how to operate the pineapple industry in South Africa I went to Hawaii and I was amazed to find that the Hawaiian Pineapple Company was ready to offer every aid and assistance so long as their advertising of canned pineapple, which they spend so much money on, to induce people—

Mr. Ashton: I do not think this has very much to do with this case.

The Court: I suppose I have opened the floodgates. I asked for the conversation. Now, I am more interested in what Mr. Otterson said to you; preferably about amplifiers.

The Witness: That it had a comparative value— He said, "You go along, and competition is healthy, and as long as you turn out a good equipment I have no objection to it," which meant the taking of a good amplifier and the rest of our equip- 1136
ment.

By Mr. Berliner:

Q. Did you tell him that you were purchasing amplifiers from American Transformer? A. I naturally have testified to that.

Q. Did he object to your purchasing and using it? A. He did not. He said as long as the royalty is paid it is quite all right. This all occurred before July of 1929.

From the Fall of 1928, when General Talking 1137
Pictures Corporation was organized, until about the Summer in June and July of 1929, I also had conversations with officers of the Radio Corporation of America, one of the licensors, Mr. David Sarnoff and Mr. Bucher. Mr. Sarnoff was president of the Radio Corporation of America; or managing director, I don't know. One of the high officials in the Radio Corporation of America. I also talked with Mr. Sawyer and Mr. Bucher. Mr. Sawyer was one of the vice-presidents of the R. C. A. Photophone Corporation, a subsidiary of the Radio Corporation of America. Mr. Bucher was also one of those vice-presi-

dents. They had several of them. During the same period of time that I was negotiating with the Western Electric I was also negotiating with the Radio Corporation for the purchase of equipment from them. I was finding difficulty in getting equipment from them, because they were holding back the supply, and unless I had their equipment I could not get any pictures, so that I had to go between the two only competitors there were, between the Radio Corporation and
1139 the Western Electric for equipment and for pictures. The conversations were on the purchase of my patent rights by the Radio Corporation, their investigation into what patent rights I had, through appointment of their counsel meeting my counsel, and their ascertaining what I was then using, and amongst other things in the use of our equipment the amplifier came up. Mr. Sarnoff said to me, the American Transformer Company—told him I had bought from the American Transformer Company the amplifiers, which his people had known through investigation,—
1140 and he said, "Well, they are a licensed firm, and that is all right."

Q. Did you have any further conversations with him concerning the amplifiers or anything else connected with your business? A. Not specially the amplifier, but the amplifier came up in the discussion of the various businesses that we had before us.

Mr. Sarnoff was never personally in the factory or the studio of the General Talking Pictures Corporation, but his office sent over their engineers to our studio in order to look our proposition over, mostly from the viewpoint of becoming a co-tenant in the studio and from the

viewpoint of seeing what we were having to offer. I can place it with Mr. Sarnoff particularly when he went off with Owen D. Young on a mission abroad. It was a public matter at the time. It was about between 1928 or 1927—between 1927 and 1928 is my recollection. I had my talk with him concerning our purchase of the "Amer Tran" amplifiers, in the early part of 1929, because again he was involved in the negotiations about the German patents. I accompanied his representative to our studio. "Amer 1142
Tran" amplifiers were installed in the studio in 1929. I don't think a special move to inspect an amplifier, but they inspected all the equipment.

As to the conference with the engineers coming down to the studio, I must be bound by the time that Mr. Sarnoff went on his commission with Owen D. Young to Europe.

The Court: I am interested in what took place when the engineers were present.

The Witness: Well, they took measurements 1143
of the studio; they examined all the equipment, both in recording and our reproducing equipment on the premises. The studio was at 318 East 48th Street and 317 East 47th Street—and after they took their measurements they sent word that it was too small and that they wanted to use another studio; that they remarked about the equipment. The American Transformer amplifier constituted a part of the equipment they inspected, amplifiers in connection with the reproducing equipment. I had no others.

Q. You are unable to fix that time any more definitely than in connection with the visit to

Europe of Mr. Sarnoff and Mr. Young; is that it? A. As to those engineers being in the premises.

Q. That is all you can do, to fix the date? A. If I could be given just a moment.

Q. Yes, you will be given all the time you need. A. I fix it in 1928.

By Mr. Berliner:

It was at the end of 1928. That is as near as
1145 I can remember. My first connection with the American Transformer direct, as distinguished from Phototone from whom I bought first, was Mr. Zelony, who is the manufacturer's agent of the American Transformer Company. Thereafter through Mr. Zelony I met Mr. Loughead, its president. I also met Mr. Schermerhorn, who I believe is vice-president, at the time. I had talks with Mr. Zelony at my office from February to July in 1929—until I met Mr. Loughead in July the first time.

The first purchases of amplifiers by General
1146 Talking Pictures Corporation were in February, 1929. That is what I understand is the date, and I believe that to be true. Mr. Zelony met me in my office, 218 West 42nd Street. He offered to sell me the American Transformer amplifier for theatre purposes in quantities. He told me that they were licensed to manufacture amplifiers and they were paying a royalty for each amplifier they manufactured and sold. He knew the business in which my company was engaged in.

The Court: How does this witness know what somebody else knew?

The Witness: I discussed it with Mr. Zelony.

By the Court:

Q. State what you said. A. He had been supplying amplifiers to me from the American Transformer Company, and I told him of the urgency of quick deliveries, because the theatres requiring those amplifiers were as the equipment was being installed depending upon specific dates and hours of opening, and the urgency of making quick deliveries to the various theatres. 1148

By Mr. Berliner:

He told me about the rights of the American Transformer Company to sell amplifiers for theatre purposes. I was anxious to get only amplifiers that would in no way infringe; I was out, or ventured into a business that claimed patents and I wanted—

The Court: We understand your frame of mind. What did he say to you? 1149

Q. What did he say to you? A. He said to me, "My company is equipped to give you licensed amplifiers, licensed by the Electrical compan[illegible]s, and give you as many as you would want for your requirements for the theatres." And I said, "I have been buying some from time to time, but I am going into this business in a large way and I would like to get a quantity of them assured to me, and I would like to get an option on them to take them up as I require for a year or from year to year.' He says, "That would

not be in my province, I would have to get the president of the company over to see you." I said, "Will you arrange to do that?" And as a result of that he brought Mr. Loughead to my office in July, the early part of July of 1929. My brother, Mr. I. W. Schlesinger, Mr. Zelony and Mr. Loughead were present at that conversation. I reviewed what I had done in business with theatres up to that point, and said it looked like a very large business and I would require several thousands of their amplifiers, provided they are licensed. He said to me, "I have the facilities and am geared up with this American Transformer Company to give you whatever you require in the way of amplifiers." I said, "Well, I want assurances, however, from you that it is manufactured under a non-infringing patent and there is no infringing of patent." He says, "That we have, because we have a license from the Radio Corporation of America and affiliated companies," and I said, "Could you give me as many as two thousand of them if I required them, in a year?" He said, "Yes." I told him I required two thousand because there were rumors in the field that their company having manufactured a very high grade amplifier might be bought by the Western Electric, and I wanted to be assured my source of supply was not cut off right in the midst of my large propaganda in sales. Before I had that talk I received a letter from the American Transformer Company with respect to these amplifiers. This, which you show me, is the letter in response to my inquiry, proving to me that they were licensed to manufacture the amplifier and that they were paying a royalty of seven and a half per cent.

Mr. Berliner: I offer it in evidence.
Mr. Ashton: No objection.
(Marked Defendant's Exhibit M.)

The Witness: At the time of this talk with Mr. Loughead I was familiar with the fact that the amplifiers supplied to us by the American Transformer Company had name plates on them and were licensed under the— I discussed that with Mr. Darby before that. I asked Mr. Loughead to give me as many assurances as he can as to 1154
the make-up of his business, as to why I would have no trouble in buying their amplifiers; and he said to me, "Of course, you will have no trouble, because our books are open to the Radio Corporation of America under our license agreement, and they inspect our books from time to time and they see from whom we are buying, and they have already seen from time to time that the General Talking Pictures is buying from us their amplifiers." This was about a week or ten days before I received their letter in July, the first letter.

1155

With respect to the option I desired for two thousand amplifiers, after asking for assurances that the amplifier they sold me for theatre purposes would be all right and I would have no trouble with it, Mr. Loughead went on to tell me at that conference in July, that the books are open to the Radio Corporation for inspection, and where the books disclosed they sell to the General Talking Pictures Corporation and other companies for theatre purposes, and that they pay them a royalty, and that they accepted and no protest has ever been made; and, furthermore, that he, Mr. Loughead, had seen an official

of the Western Electric who said that he knew about our buying the amplifier from the American Transformer Company, and said it was quite all right.

I said I would like his representations committed to writing, and after a full discussion between Mr. Zelony, Mr. Loughead and myself, at which my brother sat and listened—but did not participate—Mr. Loughead said he would have his lawyer draw them up—draw up a letter or
1157 agreement. After waiting maybe a week or ten days I received a letter, I think in the middle of July. No drafts of letters were submitted to me. When I got a communication from the American Transformer it was the first letter, in July of 1929. We did discuss the matter very fully before that letter was sent to me. I did not make any notes; but memoranda were made, notes were made.

I am familiar with the two letters written to General Talking Pictures Corporation by American Transformer, one dated July 16, 1929, and
1158 the other dated July 24, 1929.

The Court: You are showing the witness what?

Mr. Berliner: Defendant's Exhibits J and K.

The Witness: The letter of July 16th having been delivered to me by the American Transformer Company by mail—and having read it through carefully, I found that the company had omitted to protect me in case their company was sold out to the Western Electric, and I wanted them to enlarge the option to me to extend to an agreement on their part not to mutually cancel

the contract with the Western Electric or their licensors to my detriment and cut off my supply of amplifiers, and I discussed that with Mr. Zelony who called on me after receipt of this July 16th letter. He went to the American Transformer Company, as he said to me he would, and as a result thereof I received the letter of July 24, 1929. I was not to receive two letters, but I was to receive an amendment to the first letter, and all I looked at is that protection, for the option. 1160

Thereafter, my company purchased substantial quantities of these amplifiers for our theatres—for our theatre requirement, for leasing equipment to the theatres.

Neither I nor my company manufactured or sold any amplifiers for talking motion pictures. When we bought them from "Amer Tran" we leased them with other parts of the talking picture equipment to the theatres.

When those amplifiers were delivered to us by the "Amer Tran" Company they did not have any tubes in them. We bought tubes in 1161 the open market from licensees, such as Cunningham, the Radio Corporation, and from any radio stores, small and large, wherever the price affected us; wherever it was cheapest we got them over the counter. We did not buy any tubes other than those licensed. I gave strict instructions to buy nothing but licensed tubes.

I received advice of patent counsel, Mr. Darby, in connection with these tubes as well at the same time as I had about the amplifier. He advised that as long as I bought licensed tubes that I was all right. Those were the only tubes we bought.

1162 *Max A. Schlesinger—For Defendant—Cross.*

Cross Examination by Mr. Ashton:

My company received this letter you show me, marked Plaintiffs' Exhibit 33 for Identification, dated November 23, 1928, from the American Transformer Company, with a bulletin attached.

I could not identify the letter you have now handed to me, dated November 17, 1928, to the American Transformer Company, and marked yesterday for identification Plaintiffs' Exhibit
1163 32, but I assume that it was sent by Dr. De Forest. I recognize Dr. De Forest's signature. The paper marked Plaintiffs' Exhibit 29 for Identification, which you now show me, does not mean anything to me. I can recollect two letters containing what appears to be the subject matter. I do not recognize this particular document. May I ask, was this an original document?

Q. Yes. A. No, I do not recognize it at all. I do not recognize the handwriting in the upper right hand corner. I don't remember any letters being prepared. I remember a full discussion in
1164 my office, and whether or not I prepared any document, as I heard Mr. Loughead testify on the stand, I cannot recall. I may have prepared a document. The American Transformer prepared this letter of July 16th and also the letter of July 24th. They prepared them and sent them to me. But I still say that they may have worked out something in my office at the time. These letters were not typed by me. I do not know where they had them typed. I am not quibbling with you as to where they may have been typed. I am merely saying there may have been a preliminary set of notes made up in my office, and

to that extent I would like to correct Mr. Loughead. But I really cannot recollect.

The Court: Let the record show that Mr. Ashton is talking about Exhibits J and K.

The Witness: The arrangement which finally constituted the letters of the 16th was all worked out in our office. I would not say that this draft, Plaintiffs' Exhibit 29 for Identification, may not have been actually written in our office. May I 1166
look at it again? I would like to be able to help out on this. I would go so far as to say that I would not say no. I do not recognize it, though.

I never saw a copy of the American Transformer license agreement with the Radio Corporation and other companies, which is Defendant's Exhibit E in this case, until long after the suit was brought, and when we were preparing to defend it and asked the American Transformer to send me a copy, and they sent me a photostat copy. When we were preparing to de-
fend this—rather recently, quite recently. Mr. 1167
Loughead's statement yesterday in his testimony that he explained that license to me must be in error. I think he was in error.

Q. Do you know how and under what circumstances you informed Mr. Darby of the relations of the American Transformer Company and the Radio Corporation under this license, if you did not know about the license? A. I knew about licensed amplifiers. They were talked about in the trade, and well known.

I did not familiarize myself with what the license covered. I am not a patent lawyer. I left that to Mr. Darby. He did not get the informa-

tion from me. I certainly had nothing to give him in that respect. I did not see all the amplifiers. I saw some of the amplifiers.

The notices such as were on all the amplifiers that were purchased are like the notices shown in this photograph, which you show me.

(Marked Plaintiffs' Exhibit No. 34 for Identification.)

1169 That is what I understood was substantially the form of the license plate. Plaintiffs' Exhibit 30 for Identification, which you show me, is a plate such as was attached to the amplifiers, very likely, yes. I would not take full note of the details, but it is substantially what I saw. I would not look at the notice any more than having noticed it, yes; but as to details I could not say that it is word for word as on that plate. But I assume that if is, as I see it.

I am not enough of a technician, I have not enough knowledge of amplifiers to identify the
1170 panel of amplifiers you say are shown in Plaintiffs' Exhibit 31 for Identification as those my company purchased from the American Transformer Company. I see a name plate, but I could not read what is on it.

The Court: Here is a glass, if that will help you (handing witness).

The Witness: Thank you.

A. I think I see "Property of General Talking Pictures," and if that is so, if I read that, then I say that is the amplifier we used, such as are involved in this case.

1171

I recognize the document which you show as a form of contract of lease, used by my company in leasing talking motion picture equipment.

Mr. Ashton: I ask that that be marked for identification Plaintiffs' Exhibit 35.

(Marked Plaintiffs' Exhibit 35 for Identification.)

1172

The Witness: I purchased tubes prior to September 13, 1929, when this suit was brought in any radio shop, for cash—just the way the runners could run around and get them from the shops. Bland, the radio man, I just happen to remember that, being a strange name, and right near the studio. The manufacturers of these tubes I understood were licensees of Radio Corporation. Cunningham was one of the names. We did not use Raytheon until much later in the stage of our business. I think that came around 1930. I recall Mr. Darby's reference to the license agreement yesterday, March 19, 1929, of the Raytheon Company. I believe I bought the tubes from Raytheon in 1930. I looked in vacuum tube cartons lots of times. I have radios at home, in my office and around the shop and in the factories; I touched them, felt of them. I have seen notices, license notices such as have been referred to here in those tubes,—some reference to license, I could not say similar to the ones you are showing me now, but I have seen the license notices and seen the name "R. C. A."

1173

Q. The paper which I showed you was a license notice of the Radio Corporation of America, such as is included in the vacuum tube.

1174 You have seen cartons containing vacuum tubes, have you not, with notices such as this one that I read to you now: "Notice. Licensed only to extent indicated on the enclosed instruction sheet" (indicating paper)? A. Casually I have noticed these notices on every box, more or less, and referring to the carton of the Radio Corporation, of the 201A tube, which you show me, I knew they were licensed. What the terms were definitely I could not know, and I did not read.

1175 Q. And you have seen on the base of these tubes, have you not, the words, "Licensed only to extent indicated on carton"? A. I don't think I ever took the trouble to see what it says on the base of these tubes, but I knew there were stamps on it, some markings on it,—on most tubes anyway. I think I have seen some that had no markings, but were on the cartons. I did not stop to read what was on those things.

Mr. Ashton: Note that the witness is examining the base of the Radio Corporation tube type 201A.

1176 The Witness: I don't think I ever really took the trouble to look at any markings. I knew there were markings on there, but I did not know what it was.

The first purchase General Talking Pictures Corporation made directly from the American Transformer Company was in February, 1929, I believe.

General Talking Pictures Corporation, was formed about September 12, 1928. The paper you show me is a certification by the Secretary of State of Delaware and says that it was Oc-

tober 11, but I believe the certificate was applied for in September. It states, "Certificate of Incorporation of the General Talking Pictures Corporation as received and filed in this Office the 12th day of September, 1928."

I cannot state when I bought from the American Transformer Company the first type A-25 amplifier, which you say includes the types A-36 and PA-39, relied upon in this case. Those figures do not mean anything to me, Mr. Ashton. I don't know how to discriminate between them 1178
and the same would be true as regards the amplifier type 41-A. I know that there is involved in this case an amplifier referred to as a power amplifier and one as pec amplifier, but what they really do, I don't know.

Mr. Darby: This is all stipulated in the record, if your Honor please.

Mr. Ashton: These particular dates are not stipulated. I will show you the record if you wish.

Mr. Darby: The record is in evidence 1179
and we do not contest the accuracy of the record.

The Court: By the record, do you mean the reports that went in evidence yesterday?

Mr. Darby: Yes, your Honor.

The Witness: The letter from the American Transformer Company, Defendants' Exhibit M, dated May 29, 1929, came personally to my attention.

The catalogue which you show me appears to be a catalogue which we issued some time during the course of our business.

Mr. Ashton: I ask that the catalogue be marked for identification.

(Marked Plaintiffs' Exhibit No. 36 for identification.)

The Witness: Dr. De Forest was and still is connected with our company as chief consulting engineer under a retainer by the company.

Before the defendant's company was formed, Dr. De Forest had three different companies
1181 interested in talking motion pictures. They were share holding companies, two of them; one of them was a holding company. De Forest Fonofilm of New York was an operating company; De Forest Patent Holding Company was Dr. De Forest's interest in the De Forest Corporation of Delaware, which owned the patents at the time. The De Forest of Delaware owned the patents; De Forest Holding Company owned De Forest's interest in the Delaware Company, and the De Forest Fonofilm, Inc. of New York was the operating company.

1182 I had seen talking motion pictures exhibited by a De Forest Company as early as 1923. It was the De Forest Company. I knew it only as the De Forest Company. I did not know Dr. De Forest personally at that time. I am inclined to think it was De Forest Fonofilm Company; it was known then merely as De Forest, to me. There were a number of exhibitions of De Forest pictures between then and the time that our company was formed. Those exhibitions were continuous throughout that period, as far as Dr. De Forest's money would last in making pictures, and nobody else made them. Pictures were shown continuously in the theatres

from 1923 until my company was formed by the De Forest Fonofilm Company as their money lasted. They made a considerable number of pictures, which they reprinted from time to time. It was not as the theatrical business is known now; it was spasmodic, novelty business, very short sound synchronized subjects. They were novelties in conjunction with the show.

Some installation of De Forest talking motion picture equipment remained in theatres when I took the business over in the Fall of 1928. 1184

Our business was continuous from its start in September; we operated continuously to the extent that the industry permitted. Whatever the De Forest Company had to show prior to September, 1928, was limited, compared to what the industry is today. When I took it over, I was revamping the studio and revamping the manufacture of it; until I got ready for an up-to-date first class improved equipment. I did not go out for selling—

By the Court: 1185

Between January and September, 1928, De Forest recording equipment was being marketed by De Forest.

By Mr. Ashton:

This recording equipment was being offered for sale. They had reproducing equipment, but they were not geared up for large sales. I have no knowledge of it ever having been withdrawn from the market during the time I knew Dr. De Forest. I knew him in 1927. I took him to

Europe in 1927, regarding the British interests of De Forest.

Q. I ask you to look at this article in the Daily Exhibitor's Review, Monday, September 27, 1928, and ask you to read it; it is very short; I direct your attention particularly to the part on page 2, after looking at the first page, and tell me whether your testimony would be the same (handing to witness)? A. My testimony is notwithstanding, still the same.

1187 Q. Does that article not say that the De Forest equipment was withdrawn from the market about a year before?

Mr. Darby: If your Honor please, I object to that question.

The Witness: I don't care what the statement says. I know it was not.

Mr. Darby: Just a minute, please. I object to the question. That is merely another way of getting into the record something which is obviously irrelevant and immaterial and I object to the question.

1188 Mr. Ashton: If your Honor please, Mr. Berliner examined Mr. Schlesinger and gave the impression that the predecessors of this company had been in this talking motion picture business successfully during this period from 1923 on. That is just the sort of thing that I want to show is not true.

The Court: Since when has any newspaper been regarded as an infallible source of news information?

Mr. Ashton: It is not, your Honor, except that is a statement purporting to

have been made by Dr. De Forest himself, who was in intimate charge of this matter, and I want to know whether that does not refresh Mr. Schlesinger's recollection as to exactly what happened.

The Court: I think it is fair to ask if it refreshes his recollection; that is perfectly proper, but I do not think it is competent evidence.

Mr. Ashton: I am not offering it, your Honor. 1190

Mr. Darby: He has asked the witness that question, and he has answered it, and the ground of my objection is—

The Court: He said that his testimony is the same notwithstanding that statement in the paper. So we are all in agreement. A man's memory might be refreshed by almost anything you could think of, or it might not be.

Mr. Darby: But the last question to which I objected attempted to put in evidence, and into the record what the newspaper said. 1191

The Court: Yes, I will sustain that objection.

Mr. Ashton: I had no intention of putting it in as an exhibit; I simply showed it to him to refresh his recollection.

The Witness: The De Forest reproducing equipment was being offered during the year 1928 prior to my company coming into the field. I was one of the customers, as a matter of fact. There was no high class organization for sales, but it was there on demonstration in the 48th

Street office, where I saw it for the first time. I have no recollection that it was withdrawn from the market before that time. That is news to me that it had ever been withdrawn. I was present during the trial of the case in Delaware, when Dr. De Forest testified, the case which the General Talking Pictures Company brought against Stanley Company of America on our patents. I have no recollection of the detailed testimony. If you will refresh my memory on what
1193 he testified to, I will answer whether I remember it or not. I was not familiar with De Forest's activities until about 1927. I did not know what an amplifier was then. I do not remember whether he had Western Electric amplifiers or what he had. I knew that there was talking picture apparatus both for recording and reproducing.

Q. I did not get quite clearly, Mr. Schlesinger, your reference to your conversation with Mr. Otterson, about the time of Mr. Otterson's going abroad; do you know when Mr. Otterson went abroad in 1929? A. Now, you are getting on
1194 a hazy subject. I will have to think carefully of the dates here involved. When the German patent deals were up, is the time when Mr. Otterson—

Q. Pardon me if I interrupt you. The question is do you recall when he went to Europe in 1929. Now, just think it out to yourself, and don't tell us the course of the operation. A. No, I do not recall the exact date.

By Mr. Ashton:

I did not testify that Mr. Loughead stated to me that a representative of the R. C. A. had in-

spected the "Amer. Tran." Company's books prior to December. I testified that the licensors knew what they were doing by having the books open to them for inspection under the agreement. I did not say they actually inspected the books. The only time I met Mr. Loughead was in July, 1929, in my office.

The Court: Let us pause a moment, because I want to get that straight. The witness testified that his books disclosed 1196
sales of the American Transformer Company to the witness and Mr. Loughead had said that he had reported to the Western Electric officials these sales.

Q. Is that what you meant to say, Mr. Schlesinger? A. Either a Western Electric official or representative, I am not sure,—a representative of the Western Electric Company. The question asked by you was the Radio Corporation, Mr. Ashton. I referred to the Western Electric Company. There are two separate references there. 1197
One in which I said the books were open, and one where I said Mr. Loughead reported to me that he had a talk with a Western Electric representative.

By Mr. Ashton:

I had both in mind, but there are two separate references and I think they are so referred to in the letter. I did not testify that Mr. Loughead told me that the Radio Corporation of America representative had actually inspected the books at the time of my conversation with him in July.

We made our first installation of General Talking Pictures theatre apparatus in Canton, Ohio, about October or November—October of 1928, the latter part of 1928. I would not like to bind myself to the exact day and month, but it was between the date of incorporation in September and the end of the year. Yes, between the date of the incorporation and the end of the year.

We made an installation in the Strand Theatre
1199 at Allentown, Pennsylvania.

(Contract marked Plaintiffs' Exhibit 35 for identification.)

By Mr. Ashton:

If that was the actual original contract which you show me, the likelihood is an installation resulted from that, although I could not testify from my own knowledge when the installation was made. I cannot tell from this about when
1200 it was made. Sometimes an installation would not be made as a result of a contract; it would be cancelled before the installation was made. There was great difficulty in getting engineers to do the installation on time. We never committed ourselves to any definite date. I do not remember that installation specifically, but what I do remember specifically is before the close of the year 1928, the one in Canton, Ohio, was in, the first installation.

I do not know whether he advised me about the American Transformer license not being cancelled, but he told me what I could buy under it. I looked at Mr. Darby's opinion some time ago,

—a long time ago. I read it this morning again, when you referred to it.

The purpose of the visit of the Radio Corporation engineers was that they wanted to take space for recording and demonstration purposes in our studio, because there were not many sound studios in New York or elsewhere at that time. It was early in my career in the talking motion picture business, very early; before I had decided whether I might go into the recording picture business as part of my enterprise, and I de- 1202
cided that I would not, so I did not mind having another company use it.

Re-direct Examination by Mr. Berliner:

I knew that those tubes about which Mr. Ashton asked, were licensed and they had restriction notices on them. I knew it either by seeing the cartons or by the tubes, or what Mr. Darby told you. Those are the tubes used with the amplifier.

1203

PAUL J. LARSEN, called as a witness on behalf of the defendant, having been duly sworn, testified as follows:

Direct Examination by Mr. Berliner:

My residence is 18 East 198th Street, New York City. I am an electronics engineer. I am not a licensed engineer. In 1928 and 1929 I was employed by the RCA Photophone Company. That is a subsidiary of the Radio Corporation of America. I was the manager of production,

service and installation from June, 1928, until July, 1929, and manager of production from July, 1929, till October 15, 1929. I was associated also with Dr. Goldsmith of the Radio Corporation of America. He was located at the same place and was vice-president and chief engineer of the RCA Photophone. I had many contacts with him. I knew Mr. David Sarnoff, president of the Radio Corporation of America, and during my employment, occasionally saw
1205 him on the premises. I had no part in the preparation of the licenses of which Defendant's Exhibit E is a copy, between Radio Corporation and American Transformer Company, but knew of those licenses. I knew of the license to the American Transformer Company, Exhibit E. The same licenses were granted by the Radio Corporation and allied corporations to other licenses as well, there were quite a number.

Q. Just to refresh your recollection, I show you this paper.

1206 Mr. Neave: I do not see how this witness would know about the licenses,—if he states the fact, I don't know that he needs to explain it.

The Court: You can show that on cross examination.

The Witness: The Radio Receptor Company was one of the licensees.

In the course of my work during 1929, I knew that General Talking Pictures Corporation was using amplifiers manufactured by American Transformer Company. My first knowledge of that was some time in March, 1929, when Mr. Sawyer, one of the vice-presidents of the RCA

Photophone and Mr.—I don't recall his name, he was a director of the RCA Photophone Company and Mr. Harold Bucher of the engineering department—of the RCA Photophone; Mr. Carl Dreher, also of the engineering department,—we all visited the General Talking Pictures studio on 48th Street.

By the Court:

This was some time in March, 1929, in the early part of March, for the purpose of taking 1208
space there for studio activities. At about the latter part of March or the first part of April we also—

By Mr. Berliner:

While I was at the studio, I saw the equipment and apparatus of the General Talking Pictures Corporation, both recording and reproducing. I saw amplifiers connected therewith that were manufactured by and bore the name-plate of American Transformer Company. The next visit was the latter part of March, or the first part 1209
of April, 1929, when we visited, I believe—the name of the theatre is Grand, it is upstairs in the building of the Grand Opera House, I believe it is on 23rd Street, around Eighth or Ninth Avenue, somewhere around that district, we visited there for the purpose of seeing the possibility of utilizing space there for studio facilities. There was an installation of General Talking Picture equipment there. We did not examine the equipment carefully, but we saw it. I saw the American Transformer amplifier.

When I went to the studio on my first trip in March, it was at the request of E. E. Bucher,

the executive vice-president of the RCA Photophone. No representative of General Talking Pictures Corporation was along with me. Dr. De Forest was there, and I believe there was some other gentleman upstairs in the rear part of the studio, but I don't recall his name.

I knew that the amplifiers manufactured by American Transformer Corporation and sold to General Talking Pictures Corporation were used by the latter company and leased by it to theatres throughout the country. I discussed that 1211 fact with the other officials of my company. At different times, we discussed it—that discussion came up. The discussions that I remember along that line were held at our weekly official meetings between the officials of each of the respective departments. We at all times discussed the competition we had from other organizations out in the field, and our different service representatives throughout the field at all times reported back to us the type of equipment that was installed and the organization that had sold 1212 it, and we were acquainted with what equipment was being brought in by outsiders,—by bootleg equipment, as we called it.

Q. Was there any objection raised by the RCA or their subsidiaries to the use of this American Transformer amplifier used by them? A. I have no knowledge of it.

Q. Do you know whether at the same time under the same license, other licensees like Radio Receptor were offering similar amplifiers for theatre purposes? A. I don't recall that.

Mr. Neave: I do not see the materiality of that, your Honor.

The Court: The witness said, "I don't recall that," so that relieves us of any discussion about it.

The Witness: I didn't say that.

The Court: Will you read his answer?

(Answer read.)

Q. Will you repeat your answer now? A. I do know.

Mr. Ashton: I object to this line of testimony, because I cannot see that it has any bearing on this case. 1214

The Court: This line of testimony?

Mr. Ashton: We have a specific question, what did he say about that? I say that is going to suggest that other companies were selling amplifiers for talking picture purposes; other companies who had licenses similar to this American Transformer license, and I say what those other companies were using can have no bearing on this case whatever. 1215

The Court: Objection overruled and exception.

Q. That amplifiers were sold by other licensees?

The Court: Don't put the answer in his mouth. Ask him what he knew.

Q. What did you know about the use of the amplifiers made by licensees under the same licenses other than the American Transformer Company?

1216 *Paul J. Larsen—For Defendant—Cross.*

The Court: You spoke of a certain one in your previous question.

Q. The Radio Receptor, do you know? A. I do know.

The Court: He may state what he knows as to what was done by Radio Receptor Company.

1217 I know some equipment that was installed, utilizing some of their amplifying equipment, and in October, 1929, I myself made contracts for my own company, not the R. C. A. Photophone, with the Radio Receptor Company for the use of their amplifiers for use in talking motion pictures.

I do not know whether the Radio Corporation of America approved the use of these amplifiers supplied by the American Transformer Company to the General Talking Pictures Corporation.

1218 *Cross Examination by Mr. Neave:*

I was considered an officer of the RCA Photophone; manager of production, service and installation. I was concerned with the demonstrating policies in production, service and installation of all equipment throughout the United States. I had nothing to do with the patent policies of the RCA or the RCA Photophone, and was not consulted in that connection.

EMANUEL M. ZELONY, called as a witness on behalf of the defendant, having been duly sworn, testified as follows:

Direct Examination by Mr. Berliner:

I reside at the Great Northern Hotel and am a factory representative. I was special representative for amplifiers with the American Transformer Company from 1928 on. I was not employed but was made special agent for a certain purpose. I know all the executives of the company, the president, Mr. Loughead and Mr. Schermerhorn, vice-president and general manager and the engineers. During the Summer of 1928 I went over to the American Transformer Company before I knew of the General Talking Pictures Corporation. My knowledge of the talking picture industry led me to believe that there would be quite a market for amplifiers in the field. 1220

1221

Mr. Neave: I object, your Honor.
The Court: Yes, sustained.
Mr. Berliner: Exception.

The Witness: When I went to the American Transformer Company, I asked them whether they make any amplifiers for talking picture purposes. They told me that they were not familiar with the art, but they had made some amplifiers, but they did not know how they were using them. I suggested that they make an amplifier for talking pictures and I said that I could get them a lot of business. I spoke to Mr.

Schermerhorn. Mr. Loughead was not yet with the company. After, we had quite a conference about it; they did not realize the amount of business there would be—

The Court: Never mind that. Just answer the question.

The Witness: We finally decided that I was to take charge of it entirely, that is, of the amplifiers to be used in connection with talking movies. I went out and solicited business for them, for that purpose. I went out calling on the trade, everybody, including General Talking Pictures. At that time I saw their purchasing agent, a man by the name of Mr. Zeiger and the chief engineer, Mr. Tappan. A little later on, during the Fall of 1928 I met Mr. Schlesinger. I went to see General Talking Pictures Corporation in the Fall of 1928. I tried to and did sell them amplifiers for use in talking pictures. I told them that they were licensed by the RCA,—that these manufacturers were licensed by the RCA and had the conventional limited license on it, that is all. Thereafter I made substantial sales of these amplifiers to General Talking Pictures Corporation. The sales continued until about July of 1929. What happened when we sold quite a few amplifiers to the General Talking Pictures Corporation was that Mr. Schlesinger called me in and asked me if I could effect some kind of a contract where I could furnish a certain amount of amplifiers delivered at a certain time, and so on, but I had no authority to make any such contract. He suggested he wanted to buy several thousand. I had to get in touch with the company and talk it

over with Mr. Loughead and Mr. Schermerhorn, which I did. The conference was at Mr. Schlesinger's office. We had our first conference at Newark, at which Mr. Schlesinger was not present. At the conference in New York Mr. Schlesinger said to Mr. Loughead that he had done a lot of business with us and he never had any official communication as to what rights or how much American Transformers can assure him by continuing the supply in the business. Mr. Loughead said, "So far as we are concerned, we are going 1226
to make amplifiers; they are all licensed and we are selling them. No one has called our attention to it." Then Mr. Schlesinger asked Mr. Loughead for a letter agreeing that they would supply a large order of amplifiers, if they would order them. Mr. Schlesinger wanted to know whether all the amplifiers he purchased had royalties paid on them. The reply was yes. As a result these exhibits, Defendant's Exhibits J and K were sent to General Talking Pictures Corporation; I remember those letters.

Q. When you first approached General Talk- 1227
ing Pictures Corporation and you told them that the apparatus of the American Transformer Company was licensed, was any point raised about the restricted license notices? A. I don't get that.

The Court: He has already explained that there was a limited license; that was explained.

The Witness: Yes.

Q. Before the letters, Defendant's Exhibits J and K were sent, were there other conferences had in Newark between yourself and the Amer-

ican Transformer Company with respect to the contents of that letter, so far as you know? A. As far as I know, we discussed it ourselves many times—that letter, at Newark.

Q. Before it was sent? A. Before it was sent, yes.

I understood from Mr. Schermerhorn that the subject matter of the letters, Exhibits J and K, were first taken up with counsel of American Transformer Company. Before they were sent
1229 out now, in the Spring of 1929, the amplifier manufactured by American Transformer Company was exhibited and displayed and operated at the Radio Show in Chicago. I was there; Mr. George Krum our chief engineer, was there, and representatives of the RCA were there.

The Court: We can assume that they were.

The Witness: That amplifier was displayed at that convention in connection with its use for talking motion pictures, general use, everything,
1230 public address systems, radio, anything you wanted to use it for. I do not know of any protest ever made by the RCA against these sales by the company to General Talking Pictures Corporation, until December, 1930.

Q. Now, Mr. Zelony, during your work with the American Transformer Corporation, before July of 1929, that is from January to July, 1929, during that period, was any talk ever had with you, by you rather, with any representative of the Western Electric Company? A. Yes.

Q. Or the Electrical Research Products Company? A. Yes.

(Recess until 2 p. m.)

Emanuel M. Zelony—For Defendant—Direct. 1231

(Afternoon Session.)

Emanuel M. Zelony resumed the stand.

Direct Examination Continued by Mr. Berliner:

Before my conference with Mr. Loughead and Mr. Schlesinger in July of 1929 I had a conference in 1929 with Mr. John A. Otterson, a representative of the plaintiffs. It came about in this way: When the amplifier business got so big, 1232
we talked about it over at the factory, just whether we were pursuing the right course and what we were going to do about the sale of these amplifiers. I volunteered to those at our company—I said, "I will go over and see Mr. Otterson." I saw Mr. Otterson at 195 Broadway, after lunch. It was some time in June, 1929, I should say. I told him that I represented the American Transformer Company and we were getting a lot of orders for amplifiers, and that we just wondered—when I said we I referred as far as the American Transformer 1233
Company was concerned—whether we were all right in selling these amplifiers for the purpose of talking pictures. Later on as we continued the conversation, I mentioned General Talking Pictures Corporation in the conference. Then we discussed other things and we wound up by saying—well, he said so far as he is concerned there is no objection, and the only objection that he told me was that the other amplifier manufacturers on the market were selling cheap equipment, and that it spoiled some of their recordings, that the Western Electric had spent millions of dollars to improve, and that the cheaper

product on the market really did not do them justice. There were lots of other things that were said. I told him I am selling amplifiers to General Talking Pictures as one of our customers, and that I have sold to others as well. He did not make a comment, except to indicate he understood so. He did not act surprised or anything and did not object.

By the Court:

1235 He said that as far as he was concerned there was no objection.

Cross Examination by Mr. Neave:

I testified this morning about the meeting between Mr. Loughead and Mr. Schlesinger at which I was present. During that meeting no draft of letter was prepared, to be written by the American Transformer Company to the General Talking Pictures Corporation, it was just a general discussion. I saw a draft of letter of that sort with Mr. Loughead, over at the factory
1236 in Newark. It was typewritten when I saw it. It was prepared over in Newark. I would not remember whether I ever saw this paper dated July 3, 1929, Plaintiffs' Exhibit 29 for Identification, which you show me now. During my interview with Mr. Schlesinger and Mr. Loughead there was no preparation of any paper of any kind, that I know of, nor during any subsequent meeting and at which those three were present. I do not recognize the handwriting in the upper lefthand corner of that exhibit which you have just shown me.

Mr. Berliner: That is the defendant's case, except for stipulations.

1237

Mr. Darby: It is stipulated for the purposes of this case that prior to the filing of the bills of complaint herein all tubes bought by defendant and used with its apparatus here charged to infringe were tubes manufactured under license of the tube patents of plaintiffs and Radio Corporation of America, and that they all were sold with one or the other of the license notices restricting the use of the tubes, which have heretofore been spread upon the record.

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It is likewise stipulated that on June 27, 1929, the defendant company, General Talking Pictures Corporation and the De-Forest Fonofilms, Inc., filed a bill of complaint against the Stanley Company of America in the United States District Court for the District of Delaware, charging infringement of four patents owned by the plaintiffs in that action, and the equipment charged to be an infringement in the action was Electrical Research Products equipment, talking motion picture equipment, and that Electrical Research Products openly undertook the defense of that case and controlled and directed the defense of that case.

1239

The defendant rests.

PLAINTIFFS' REBUTTAL.

Mr. Ashton: Am I correct, Mr. Darby, in understanding that you agree that the Dr. Arnold referred to by Mr. Kendall in

his testimony is the Dr. Arnold who was patentee of several of the patents in suit; and also that Dr. Arnold died last July?

Mr. Darby: That is correct.

Mr. Ashton: Do you agree that you will make no point of the matter that Mr. Kendall testified to—namely, that these suggestions and particularly as regards the subject matter of Arnold patent 1,448,550, were made to him by Dr. Arnold; also

1241 with respect to patent 1,520,994?

Mr. Darby: The request is pretty broad, Mr. Ashton. The witness has testified to that. Now you are asking me in advance of argument whether I am going to attack the testimony of the witness.

Mr. Ashton: I spoke to Mr. Darby about this just at the conclusion, and in an effort to avoid calling additional witnesses. I am not asking Mr. Darby or insisting that he stipulate it. It is a question whether we can eliminate these witnesses, and I

1242 understood you to say we would attempt to state it here.

Mr. Darby: What I mean is this: Mr. Ashton several times during the taking of testimony has made the statement that he has carried the date of the invention back. I criticized his statement at the time. The evidence is in. Whether it carries it back or not is something that is going to be determined later. Now, I do not want to admit that it does and do not want to say that it does not, at this stage of the case certainly.

Mr. Ashton: Then, we will call the witnesses.

Mr. Darby: If you think it is sufficient, all right; but if not you better put on your additional proofs.

FRANK N. WATERMAN, recalled by the Plaintiffs, in rebuttal, testified as follows: 1244

Direct Examination by Mr. Ashton:

Q. Refer now to the prior art which has been discussed with respect to the Lowenstein patent in suit No. 1,231,764. The first is the De Forest patent 841,387. A. The De Forest patent shows a variety of ways of controlling the current in a tube. Fig. 2, which as I recall was chiefly discussed, shows a tube having a filament and two electrodes D and D^1, D^1 serving as an input electrode to receive the signal and taken from the antenna V from the air and detected by a detector T^{11}. The function of this detector is to separate the radio frequency from the received modulation that it carries, and permit the modulation to be heard in the output device R, or to be otherwise recognized by the actuation of that device. 1245

The figure shows a battery B^{11} in the input circuit. It was customary with many of the detectors employed at that time to employ a sensitizing battery, sufficient current being sent through the detector to keep it in its most sen-

sitive condition. The battery B^{11} is not described as to function, nor indicated as to polarity, but it is presumably the ordinary sensitizing battery for the detector T^{11}.

For this purpose it would be necessary that it should be poled with its positive pole to the element D in the tube, since only in that event could the sensitizing current flow through the detector T^{11}. The batteries shown in the patent
1247 are all indicated as to direction of connection by plus and minus signs, with the exception of this battery B^{11} and the battery B^{111} in Fig. 4. In the case of Battery B^{111} it is entirely immaterial which way the battery is poled.

I note that the use of symbols in the patent does not follow any consistent scheme. The battery symbol consisting of a long thin line and a short heavy line is used in one sense or the other indifferently. For instance, in Fig. 2 the heavy lines are plus; in Fig. 3 the heavy line is minus. Thus there is nothing to indicate
1248 polarity in the event that the batteries do not have the polarity indicated.

By the Court:

Q. In 1907 was there a convention in reference to the marking of the batteries? A. No, your Honor, way back in the times when I was in college I was taught that there was. The heavy line which was supposed to represent the consumable element was negative, but that convention fell into disuse and there has been no consistency in the use either in 1906 or since.

By Mr. Ashton:

Q. Will you now refer to the De Forest patent 879,532. A. This patent shows for the first time in the art a grid audion; that is, the 3-electrode tube with the grid element for the control element. It was pointed out, as I understood, that the input circuit, namely the circuit connecting the grid to the filament, was returned to the negative side of the filament battery in both cases.

By the Court:

Q. What do you mean by both cases; in Figs. 1 and 2? A. That in Figs. 1 and 2, yes.

Q. Which is the grid in Fig. 2; is it F? A. There is no grid in Fig. 2, but the control element is A^1.

Q. That takes the place of the grid? A. It takes the place of the grid, yes, your Honor.

The Witness: (Continuing.) The first electron tube to be used in connection with wireless telegraphy was the 2-electrode tube of Fleming. It had a hot filament and a plate, and was originally used without any local battery. The signal was put into the circuit connecting the plate element and the filament, and Fleming directed that that external circuit should go from the plate element to the negative side of the filament battery, and that became customary, and the illustration of this De Forest patent is in accordance with that conventional use. But the grid is not connected to the filament in either of these cases, because the circuit is broken by the con-

1252 denser. Therefore, as a matter of fact, the grid gets no polarization or potential from the filament whatever, but is what is called a floating grid. If the condensers were not present, then the grid would have the normal potential of the negative end of the filament, and would be in accordance with conventional practice with respect to the 2-element tube. It would not, however, be ultra-negative.

1253 By Mr. Ashton:

Q. We will now take up the Stone patent 884,-110. A. The Stone patent points out at page 1, line 60, that the patentees have found that the sensitiveness of the audion when connected in the absence of a polarizing means in the grid circuit was greatly impaired from causes which were obscure, and therefore not discussed, and it states that the probable cause is that the conducting member G becomes negatively charged.

1254 In the next paragraph it is stated that the sensitiveness of the audion may be greatly increased by inserting a battery shown at Z, polarized to make the grid positive with respect to the filament. The tubes of that day often exhibited the effects of gas in the globe, and the use of the positive battery is probably suggested by Stone and Cabot in connection with such tubes in a circuit calculated to operate on what is known as plate side detection, in which case the grid is given a bias by a battery and operates to produce the rectifying or detecting action necessary in wireless telegraphy.

Q. The next patent is De Forest 995,126. A.

1255

It was pointed out, as I understood the testimony, in connection with this patent, that there are three illustrations of a 3-element tube. One at the right in Fig. 1, one at the left in Fig. 2, and one at the lower right in the same figure. It was stated that the grid of each of the three tubes was connected to the negative side of the battery heating the filament. This is true of the circuit, but it is not true of the grid. That is to say, in each case a condenser is included in the 1256
circuit so that the grid has no direct current connection to the filament whatever. That is to say, there is nothing to determine its potential with respect to the filament in either case. The system is a complex one, and I do not understand that it was described from any other point of view than that which I have just mentioned.

Q. Take up the Von Lieben Patent, 1,038,910. I will ask you if you are familiar with the statement and the opinion of the Court of Appeals in the Wallerstein case which I read from the other day, and if they are correct statements so 1257
far as you know from the scientific point of view? A. I am familiar with them, and they are correct. The Von Lieben patent shows a tube of a very special character, which might be described as a Geisler tube built on top of an electron discharge device. That is to say, there are two chambers in this tube whose separateness, except as they are connected by the perforations in the partition H, is an essential matter. The space above the sieve member H and between it and the anode A acts like a Geisler tube, having the parallel electronic and the positive ion streams, and having the dark space character-

1258 istic of such a Geisler tube formed just above the sieve member H. The sieve member H is made positive with respect to the hot filament member and causes electrons to pass from the cathode to the sieve. These acquire a considerable speed and some of them heat the sieve and some of them go through the holes. Those that go through the holes set up by impact on the gas molecules in the upper portion a state of what
1259 is known as impact ionization which becomes self-perpetuating. The electrons act as bullets which strike the gas atoms and deflect therefrom other electrons, with the result that there are positive ions left. Those positive ions move in one direction in this upper space, while the electrons move in the opposite direction.

Now this is the essential mode of operation. It is essential that the sieve should be positive in order to get the electron stream from the cathode up to this ionizing velocity. The signal imposed upon the sieve member acts to vary
1260 the limits of the dark spaces and in the operation of the tube one can see the dark space and see it fluctuating, fluttering just above the sieve.

The action, therefore, is not in the least like that of the type of tubes known as audions with which we are concerned in this case, and the positive polarization of the sieve is essential, the device will not operate in any other condition. The positive potential is obtained by a potentiometer shown at the left hand c in Fig. 2, which is connected across the cathode, the movable point on the potentiometer being connected to the sieve. The adjustment as shown is about in the middle, which means that the sieve has ap-

proximately the potential of the middle point in the length of the cathode.

In Fig. 2-A there are two cathodes, the upper one K1 being the one primarily concerned in the operation of the tube. It is supplied by a battery B1, only a portion of that battery being employed to heat the cathode K1. The whole battery, however, is connected to the sieve so that in that event the sieve has a potential greater than any part of the cathode K1. 1262

In Fig. 3 the cathode is of different construction, but the mode of polarizing the sieve member is the same as that in Fig. 2. In this instance the cathode takes the form of a sort of condensing mirror.

By the Court:

Q. The battery is B in Fig. 3? A. No, your Honor, that is the microphone battery. The battery is Q, not shown. It is not shown whether it is a battery or what the source is, but there is 1263 a source there, the terminals of which are marked plus and minus, and the potentiometer c is connected across two lead wires going to heat the cathode. The movable arrowhead on that potentiometer resistance connects to the sieve member H, and again it is a positive potential that is applied, as is essential for operating purposes.

By Mr. Ashton:

Q. Will you now refer to the Mathes patent in suit, the Grid Biasing Resistance Patent No. 1,426,754, and discuss first the Arnold Patent

1,129,942, which was selected by Mr. Cloud as the best reference against this device. A. Fig. 5 of the Arnold Patent 1,129,942, shows an arrangement in which three audions are connected in tandem relation, the first two being high voltage amplifiers and the third being the power output or high current tube. These are resistance battery couples. The arrangement is what is known very often in the art as a direct current
1265 amplifier. It will respond to direct as well as to alternating current. The tubes are coupled; that is to say, the left hand tube and the middle tube are coupled together by virtue of resistance 14, and the grid of the middle tube is conductively connected to the top end of that resistance. That would mean that the grid took the potential of the top end of the resistance 14, in other words the same potential as the plate of the preceding tube, were it not for the presence of the battery 11.

The filaments of these tubes are supplied by
1266 the battery 12 and are connected in series—that is, seriatim one after the other, starting from the positive pole of the battery 12 and following to the right a wire goes off to a resistance erroneously marked 14—the number 14 should apply to the resistance just to the left of it—then up through the filament 9, then to the left and through the filament 5 of the middle tube, again to the left through the filament 5 of the left hand tube, back to the battery 12, negative terminal.

Take for example the grid of the middle tube. The voltage which it would get would be the voltage of the battery 13 minus whatever loss

of voltage occurred in sending the plate current of the left hand tube through the resistance 14, and minus the loss of voltage through the filament 5 of the left hand tube. This would be a very high voltage and would cause the middle tube to operate in an exceedingly defective manner if it operated at all.

There is, therefore used what is commonly known as a bucking out battery 11, which battery opposes the voltage on the plate 4 of the 1268
left hand tube, cancels it out, and has enough voltage left over, so to speak, to make the grid 3 of the middle tube about 5 volts negative with respect to its filament.

In other words, without the battery 11 of the grids of the middle and right hand tubes would be highly positive. It does not appear what exists to the left of the left hand tube, but a battery 11 is shown for establishing a negative bias on the grid of that tube also. The negative bias, therefore, is obtained in the case of each tube by the use of a battery 11. In the case of Fig. 7 1269
the input circuits of the three right hand tubes, each of which is marked 2, is derived from the battery 11 which in exactly similar manner to Fig. 5 bucks out or overcomes the voltage of the plate battery 13. But since the filaments are in series the two right hand batteries 11 are positively poled with respect to their grid elements in order to preserve on them the same negative bias as exists on the middle tube. In other words, in the outcome all three of the grids of the tubes 2 of Fig. 7 receive their negative bias directly from the battery 11.

Q. Now the other Arnold Patent 1,129,943.

A. This arrangement is essentially the same in Fig. 2 of patent 1,129,943, as in Fig. 7 of patent 1,129,942, so far as concerns the grid circuits. The grid of the tube 4 is biased by the battery 6, which overcomes the voltage of the battery 9, the relation being that I have described with reference to Fig. 5 of the other patent 1,129,942. The grids of the three tubes 5 obtain their bias from the battery 6 located just
1271 at the left of the middle tube, and the batteries 12 are to preserve the grids of the two right-hand tubes at the voltage determined by the battery 6 last named, in spite of the voltage drops in their filament.

Q. Will you now take up the Reisz Patent, tab 16, No. 1,234,489. A. The Reisz patent shows one of the Von Lieben type of tubes and the sieve H derives its bias from potentiometer W^1, connected across the filament terminals, and therefore the sieve voltage corresponds to that of some point of the filament and is sufficiently
1272 positive to a sufficient part of the filament so as to cause the requisite electron velocity to cause the dark space created in the upper half of the tube to be suitably located with respect to the sieve element.

The Court: Will you please read that? (Answer read.)

The Witness: Is not that clear to your Honor?

The Court: I cannot say it is clear, but that is not your fault.

The Witness: I will be glad to explain it.

The Court: This (indicating) is the filament?

1273

The Witness: The filament is K.

The Court: Where does the filament receive its current, from B^1?

The Witness: From the battery B. The plus terminal is marked by the right-hand terminal of battery B^1.

The Court: Oh, yes, I see, right above.

The Witness: Plus. Those circles indicate binding posts. The current flows up, through to the 1274
right-hand end of the filament K, then through the filament and from its left-hand end down to the switch S. Assume that the switch S to be closed, the flow takes place. Of course, if the circuit is broken at that part, no flow takes place and current then returns from the switch through the minus terminal to the minus end of the battery, thereby heating the filament. The potentiometer W^1 is connected across the leads or lead wires from the filament K, so that even if the filament K were broken, for example, the current would continue to flow through the potentio- 1275
meter. In other words, in both the Von Lieben patent and the Reisz patent, the potentiometer is not a conductor carrying the same current which heats the filament as in the Mathes patent, but it carries a wholly independent current, but since it extends from one terminal to the other, a drop of potential will occur through it, which represents the same drop of potential as the drop of potential in the cathode or filament, although it is not produced by the same current. Then by tapping that potentiometer resistance W^1 at a suitable point, a definite amount of the total potential of the filament, as measured from

its left-hand or negative terminal can be taken up to the sieve member.

With respect to all the rest of the filament, which is the left-hand portion of the filament, the screen is positive and it operates in virtue of that fact, because electrons will only be attracted to positive circuits. They are therefore speeded up and given the necessary velocity so that such of them as happen to hit holes instead
1277 of solid portions carry through with sufficient projectile action to disrupt the atoms on the upper side, and when that occurs with sufficient violence, the ejected electrons, that is the electrons ejected from the atoms, will themselves collide with other atoms, and a state of self-perpetuating ionization is created, so that there is, to a large extent, a separation of the atoms in the upper chamber R in this Reisz patent into positive and negative ions.

The negative ions, being the electrons, and the positive ions being what is left of the atom.

1278 Q. Mr. Waterman, will you take the Colpitts Patent No. 1,388,450, tab No. 27? A. The Colpitts Patent 1,388,450, shows a radio transmitter and the portion of the apparatus that was referred to as I recall, was the right-hand portion of Fig. 2; two tubes 27 and 28 are in this instance, operated in parallel. Their filaments are heated in parallel by a generator 61 of alternating current. Across the terminals of this generator, is an inductance 62, this being alternating current, the inductance offers a high impedance. It is serving as a potentiometer across the terminals of the generator, and from the middle point of this potentiometer or thereabouts,

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a point, in other words, which is supposed, as I understand, to have the mean potential of the filaments of the tubes, there is connected to resistance 64, to the lower end of which is connected the negative pole of the plate voltage generator 66, shown at the right of the resistance 64.

This resistance 64, together with the two halves of the inductance 62, is therefore in series in the plate circuit of the tubes.

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The grids of these two tubes are connected through the input circuit to the lower end of the resistance 64 and therefore to the negative terminal of generator 66. The effect, therefore, is to cause the grids of tubes 27 and 28 to be negative by whatever flow of potential is exerted in the resistance 64, and the two halves of the inductance 62 in parallel by the flow of the plate current. This is none of it filament heating current, but is the space current of the tubes that is flowing through the resistance 64 and which causes the bias, and the difficulty with that arrangement, as shown is that it tends to compensate out the signal. It has a de-amplifying effect produced in the input of the tubes which makes it highly objectionable in an amplifier.

1281

BURTON W. KENDALL, recalled as a witness on half of the plaintiffs, in rebuttal, having been previously sworn, testified further as follows:

Direct Examination by Mr. Ashton:

Q. Mr. Kendall, in your testimony the other day, you stated that Dr. Arnold had suggested to you—Dr. Arnold made the suggestion of the

use of this potentiometer gain control across the input circuit of the repeater, which I had at Philadelphia in March, 1914, certainly later than the 17th of February and certainly as early as or earlier than the 7th of March, 1914. I have in my record book No. 25, p. 87, a record of some experiments we made on it about the 17th of February, and that is correct. Just before this one was photostated, that is dated 2/17/14, and
1283 those were tests of audions regarding gains with different inputs. I remember that as soon as he told me of this, we made a few brief tests in the laboratory, and within a very few days I went out to install this, and repeated this experimental use in Pittsburgh. The date, of that, of course, is given in the previous testimony in connection with this photostat.

Mr. Darby: No cross examination.

1284 Mr. Ashton: I would like to offer the additional page 87 of the notebook referred to by the witness known as Notebook No. 25, and ask that a copy be substituted for the original.

(Marked Plaintiffs' Exhibit No. 37.)

William Wilson—For Plaintiffs—Rebuttal—Direct.

1285

WILLIAM WILSON, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

I prepared the memorandum, Plaintiffs' Exhibit 17, about which Mr. Espenschied testified the other day. I prepared it in May, 1915. It 1286
was completed May 26, 1915, the date of the memorandum. I prepared some of the drawings and Mr. Crandall prepared some of the others. They were prepared from the actual—those that I prepared, were prepared from the actual apparatus.

Drawing ES-160,355, dated May 24, 1915, was prepared on or about that date. It was completed on that date. The receivers were completed on or about this date. I do not know anything more exact than that, a little earlier. Some of them were completed before this drawing and some 1287
were completed a little after this. I had seen the receivers at the time this drawing was prepared. At the time I prepared this memorandum I was working in the research department of the Western Electric Co., as research engineer. I now live at Jefferson Road, Short Hills, New Jersey, and am employed by the Bell Telephone Laboratories. I am assistant director of research.

I operated one of the receivers myself at San Diego, California. I received signals there. It was the end of September or the beginning of October, 1915, I forget the exact date.

1288 *Frank N. Waterman—For Plaintiffs—Recalled—Rebuttal—Direct.*

Cross Examination by Mr. Darby:

As to what became of those receivers, all that I remember about the one I had is that it was shipped back to New York. I think I saw one of them around a little while after that, but since that I don't know what happened to it. I do not believe they were sold, but I cannot say certainly. They were built in the engineering de-
1289 partment of the Western Electric Company. I think they were not sold to the Telephone Company, although I don't know.

FRANK N. WATERMAN, resumed the stand.

Direct Examination by Mr. Ashton (Continued):

Q. Now, will you take up the Arnold patent in suit, No. 1,329,283, the Power Circuit Patent. I
1290 would like to ask you if you recognize the tube which I hand you? A. I do.

Q. State what you know about it. A. That is a three-electrode audion. I believe it to be one that belonged to me, which I bought, oh, perhaps in 1913 or 1914. I presume it was in the Winter of 1913-14, from Dr. De Forest, and which I used until I burned out both the filaments. All of the audions, so far as I know, had two filaments.

Q. Why did they have two? A. The filaments were very short-lived and the presence of two filaments was intended to double the life of the tube. Sometimes it did and sometimes it did not.

1291

Sometimes the tubes went bad when one filament burned out.

Q. Was this tube the same tube that was an exhibit in the Wallerstein case? A. Yes.

Q. You produced the tube from your home during the trial of that case? A. I did.

Q. Where had you had the tube during the period prior to that? A. Oh, it had been stored with a lot of old apparatus.

1292

Mr. Ashton: This tube was Plaintiffs' Exhibit No. 52 in the case of Western Electric Company, *et al.* v. Wallerstein.

Q. The tube has been in the possession of counsel since that time? A. Yes, so far as I know.

Q. Now, will you describe briefly the construction of the tube with respect to the two tubes, Exhibits 12 and 16, and just make a brief comparison. A. This tube is a typical sample of the audion, as I knew and used them for a good 1293
many years. It has a small bulb originally containing two tantalum filaments. They operated, as I recall, on about four volts and took something over half an ampere, if my recollection is correct. Adjacent to and parallel to the plane of the filaments is a grid member formed by bending a wire back and forth to form a grid, looking like a succession of hairpins and parallel to the grid and spaced from it a short distance, there is a small plate element. The last two named elements were provided with lead wires, leading up through the top of the bulb, and it was customary to find them, as one purchased

them, covered with so-called stockings, the wire of the grid being a green stocking and that of the plate a red stocking.

The bulb was equipped with a miniature screw socket for screwing into a socket connected with the A or filament battery. In use, the filament circuit was the input, and the plate and filament circuit the output. The bulb was supposed to be evacuated. They varied very greatly in their
1295 vacuum, and were exceedingly erratic in their performance. It was quite customary for them to seemingly go bad, and this was apparently associated with a cleaning up of the gas. The battery that one could use on the plate circuit without producing the blue glow gradually increased, and the bulb quite commonly ran down in their apparent sensitiveness as that took place.

The blue glow, I might say, was a state of self-perpetuating ionization. The tube became the field, with a blue halo, and when that happened, all functioning of the tube ceased. The current
1296 rose to a very great extent, so much so, that if one had a very delicate measuring instrument in the circuit, it was very dangerous to the instrument. The normal current was extremely small, but when the gas ionization occurred, the current was very enormously greater. Except that the structure has a filament, a grid and a plate, there is little resemblance between these tubes and Exhibits 16 and 12.

Exhibit 16 has a grid of finely spaced fine wire, that is wire finer than in the original audion and more closely spaced. The separation of the grid from the filament is of the same general order as in the audion. The plates are

more widely separated. The Exhibit 12, however, has the grid wires much more widely separated from one another than in the audion or in the Exhibit 16, the plates are much larger. In both of the tubes, Exhibits 12 and 16, the filament is larger than the filament in the old audion.

Q. Was the electron emission sufficent in the old audion? A. It was very apt not to be. That may have been one reason why the tubes performed so badly when the gas cleared up. In 1298
general, the old audion had, as one might say, the defects of both kinds of tubes typified by Exhibits 12 and 16 and the advantages of neither.

Q. As to the power output of the type M tube, Exhibit 12, as compared with the audion, what would you say? A. There isn't any comparison at all. The output of the audion was exceedingly trivial, while that of the type M tube, Exhibit 12, is enormously greater.

Q. Of an entirely different order, would you say? A. Oh, yes; entirely.

Q. Now, mention very briefly the Seibt Pat- 1299
ent No. 1,012,456, cited against this Arnold patent in suit 1,329,283. A. The Seibt patent shows what is known as an arc transmitter in a very schematic way. Off to the right of each of the figures, there is supposed to be a source of direct current, of large volume, together with certain stabilizing devices necessary to stabilize the arc. The arc jumps across the gap D and in shunt to that gap, there is the circuit CBE. C being a condenser; B an inductance acting as an autotransformer and E a microphone.

The characteristics of this circuit determine the oscillation which takes place in the current

in the arc. In other words, a suitably circumstanced arc with suitable inductances and resistances in its supply line can be fed into a state of oscillation so long as there is enough to keep it being regular; the circuit CB serves something like the pendulum of a clock to keep that arc in a state of oscillation. The extent of the oscillation will be determined by the resistances. The microphone E in the circuit covers the re-
1301 sistance, and when one speaks into the microphone, that resistance varies the amplitude of oscillation, the extent of the current variation, in other words is affected and since the radiating antenna A is connected to the top and bottom ends of the coil B and is therefore influenced by the voltages set up in this circuit in shunt to the arc, which voltages are very much higher than the direct current voltage across the arc when so affected and the antenna radiates energy, and the high frequency waves would carry modulations representing the vibration of the micro-
1302 phone in response to the voice. The patentee goes into the theory of the resistance relations in the circuit and deduces that the greatest efficiency as stated on page 2, lines 3 to 6—the greatest efficiency will result when the resistance of the microphone is equal to the resistance of all the rest of the system, which must include, as I understand it, the resistance of the local circuit outside of the microphone and the actual resistance to the so-called radiating resistance of the antenna.

What he really solves there, is not maximum efficiency, but maximum output.

The mathematical treatment, so far as he goes

is simple enough, but he does not seem to include all of the factors. However, as far as it goes, it shows that the maximum output is attained when the resistance in the microphone is equal to the resistance of the rest of the system. It is a case of an investigation to determine what the relations are in a circuit of this kind. There is a general law where we have a simple transfer of energy from a source to a circuit, that the maximum output will be realized when the 1304
resistance of the load external to the source circuit is equal to the resistance of the source itself. That, so far as I know, in electrical matters grew out of the necessity for arranging batteries in a telegraph circuit in such a way as to get the greatest output. I know when I was in college, the standard problem we had in electrical engineering in that line were battery connection problems.

Q. This patent was then a specific application of this law that you have mentioned, the general law? A. Well, it is an invention to find out 1305
whether the law held in a special case of this sort. It never could be presumed the law was going to hold; you had to find out.

Q. So the mathematics at the top of page 2 were directed to that? A. Yes, all the mathematical discussion of the patent is directed to that ascertainment.

Q. And the conclusion deducted from those mathematics were to the effect that you have stated? A. Yes, on the basis of the assumptions made. I do not think it is a very thorough investigation.

Q. We will pass over the Arnold Patent 1,129,-

943, which was filed on the same date as the original patent in suit, 1,329,283, this Arnold Patent 1,129,943, being the reference which was selected by Mr. Cloud as the best reference and also by the patentee of the patent in suit.

Now, mention briefly the Colpitts Patent 1,129,959, tab 12. A. This patent goes, as I understand, to an amplifier arrangement designed particularly for ocean cable telegraphy. In ocean
1307 cable telegraphy, the rate at which signals can be transmitted through the cable is very low, so that treating those signals as alternating currents, they are of the order of one or two cycles per second, and it is therefore a matter of extraordinary difficulty to make anything in the way of a transformer that would function, since the output of the transformer depends upon the alternation of the current flowing in, the higher the rate of alternation, the smaller can be the transformer, generally speaking.

1308 By the Court:

Q. Is the rate of alternation the same as frequency? A. Yes, your Honor. What Colpitts proposes is to connect into the cable circuit shown at the left in Fig. 1, a device whose input circuit can be wound so as to match the cable effectively. This device has an exceedingly high internal resistance. It is a tube device by Dr. Arnold and shown in some of his patents, and what Colpitts proposes is to connect the output of that high resistance tube to the input of a bunch of audions arranged in parallel. The output circuit of the audions being connected to the

siphon recorder 5. The specification, page 1, line 19 states that the law of electric circuits which I have referred to—

Q. Which line was that, please? A. Line 19. The patentee states at the top of page 3 that by using a number of audions in parallel, the combined impedance of the output circuit may be made of the same order of magnitude as the receiver or siphon recorder. In other words, Colpitts had to resort to the expedient of using 1310 a large number of audions in the attempt to get a sufficient current through the receiver 5, in order to operate it.

By Mr. Ashton:

Q. Does the patent contain any disclosure of a high power tube, such as disclosed in the Arnold patent in suit? A. No, it does not. It operates tubes having high plate circuit impedance. Each must be connected in—no, I don't think you can even say that. It refers to tubes having small currents and in order to get enough 1311 current, he had to use a large number of tubes, each contributing its part to produce sufficient current.

Q. Would the output of these tubes be of the same or different order than in the patent in suit? A. So far as I know, the Arnold patent in suit for the first time discloses a tube having a high output current. This was the first high output current tube of the art, so far as any disclosures in the patent is concerned. In fact, the patent essentially says that.

Q. Do you have with you a copy of the patent for the mercury arc device of Arnold, which is

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the first tube shown in this circuit of Colpitts Patent 1,129,959? A. Patent No. 1,118,172, of Arnold shows the sort of tube that is used in the first stage of this cable amplifier of Colpitts. The tube in general, is a mercury arc in which the element 5 is the main anode and the mercury pool 6, the cathode.

The arc is started by tipping the tube so that mercury from the compartment 4 runs over and

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touches the mercury in compartment 6, and then straightening the tube, an arc is formed, which is at once set up or duplicated between the anode 5 and the cathode 6.

The tube has a small auxiliary anode 9 and 2, plates 7 and 8, which are arranged at right angles to the normal arc stream. When a signal comes in from the microphone 16, it is connected through transformer 15 with the coils 11, 12; the magnetism set up by those coils causes ions in the arc stream to be deflected there towards the plate 7 or plate 8 and therefore cur-

1314

rent is caused to flow in the output windings 29, 28, which are windings of the transformer, called a split transformer. The battery 27 connecting between the auxiliary anode 9 and the two plates 7, 8, the flow of current in the coils 28, 29, sets up currents in circuit 17, containing receiver 18.

Q. Is this type of tube in use today as an amplifier? A. No. As far as I know, it was never used regularly. Dr. Jewett in a paper delivered, I believe, before the American Institute of Electrical Engineers, described its experimental use in a transcontinental line under the care of experimental engineers, but as far as I know, it has never had regular commercial use.

Q. What would happen if a tube broke, for example, in a telephone plant, would it spill mercury? A. It would spill mercury all over the neighborhood. It would not be at all a nice thing to have in a telephone plant where high insulation is of the essence.

Q. Will you point out to the Court which specification to refer to? A. I cannot locate it now.

Q. Will you refer to the patent in suit, 1,329,283, and state with respect to the invention of 1316
that patent such differences as there may be in your opinion, from the disclosure of Patent 1,129,959?

The Witness: Let me have the question, please.

(Question read.)

A. The disclosure of Patent 1,129,959, is that by the use of a large number of audions connected in parallel, a sufficient output current can be obtained to operate a low resistance—comparatively low resistance device. The Arnold pat- 1317
ent in suit shown is very different and much more useful an organization, in which the circuit of the output device is matched by the construction of a single tube whose output circuit impedance is of the same order as that of the output device itself. When the audions like the samples which have been shown me—I don't know whether it has been offered or not—

Mr. Ashton: I am going to offer it at the conclusion of this deposition.

A. (Continuing.) Like the audion of my own, there was no known relation that existed between

1318 the construction of the elements of the tubes and the performance of the tube. So far as I know, it was Arnold who unravelled that mystery and found out how the performance of the tube could be made to depend upon the construction of its elements.

By the Court:

Q. Is that what is called the geometry of the
1319 tube? A. Yes, your Honor, that is known as the geometry of the tube, the relation between the geometrical elements of the tube and the performance of the tube, was a complete mystery. Arnold found that it was possible to make tubes have almost any characteristics that were needed, and so far as I know, Arnold was the first to recognize the fact that in convection current tubes of this sort, there was an alternating current resistance which was quite different from the apparent resistance of the tube which could be matched with the load.

1320 By the Court:

Q. By the load, you mean the output? A. Yes, the impedance of the output circuit. As I understand it, the invention described in the claims in issue is the production of a combination in which you have resistance of output devices equal to internal resistance of the tube by proportioning the construction of the tube.

By Mr. Ashton:

Q. DC? A. AC.

Q. I mean AC, excuse me. A. Colpitts did it by putting in tubes in parallel; Arnold did it by

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making a tube whose current fitted the device it was to be connected to, because the impedance was made low enough to match the impedance of the output device.

Q. If you are finished with this Colpitts patent, I believe you were, were you not? A. Yes.

Q. Will you mention briefly Langmuir Patent No. 1,558,426. If you recall, Mr. Darby read from this patent on his examination of Mr. Cloud. He read from page 3, lines 8 to 14. A. The statement on page 3, lines 8 to 14 is the geometrical proportion of the tubes affecting the amount of current to flow at a given voltage, but they remain fixed for any given device, and then he continues to a consideration of the law that the current will follow with respect to the voltage applied to the plates, letting a symbol represent that constant effect of the geometry. That passage does not say at all what the effect of the geometry is. If there are any other passages, I have not got them marked.

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Q. You will see one marked, page 3, line 93. A. Oh, yes, page 3, line 93:

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> "The devices made to operate in accordance with my invention are capable of transmitting currents materially exceeding 1/10th of a milliampere without causing positive ionization."

Of course 1/10th of a milliampere is an exceedingly trivial current, of not so very different an order, somewhat larger, but not so very different order of those of the old audions, and in no sense a high current output tube, where the current is measured in many more amperes.

1324 *Frank N. Waterman—For Plaintiffs—Recalled—Rebuttal—Direct.*

Q. Does he describe the structure of the grid with wires very closely adjacent to each other, but without contact with the cathode? A. Yes, at the bottom of page 3, line 129.

Q. What would that be, a high voltage tube? A. That is a high voltage tube, but not a high current tube. There is nothing in the patent at all that I have been able to find, which indicates the possibility of construction of a high

1325 current output tube.

Q. Is this patent concerned largely with the matter of vacuum in a tube? A. Yes, this is what I know as the high vacuum tube and it is concerned primarily with conditions affecting the vacuum and the application of the so-called three half power law, as the means of telling when the vacuum was high—the presence of gas interfering with the law.

Mr. Ashton: I offer in evidence the old De Forest tube referred to by the wit-

1326 ness as Plaintiffs' Exhibit No. 38.

(Marked Plaintiffs' Exhibit No. 38.)

Mr. Ashton: And the patent to Arnold No. 1,118,172, granted November 24, 1914, which is for the Arnold arc.

(Marked Plaintiffs' Exhibit No. 39.)

Q. We now take up the Arnold Patent 1,349,-252, tab No. 4, Straight Line Characteristic Patent. Will you kindly explain briefly to the Court the curves which were previously put in evidence, to recall to his mind how that operates. A. It might assist in the understanding of the matter, if I were to point out briefly how these

characteristic curves are taken, and I will refer, if I may, to Exhibit 5 in connection with Exhibit 24.

Exhibit 5 shows the simple audion diagram, and if we suppose, where the word "output" appears on the diagram, a measuring instrument adequate to measure the current flow in the plate circuit is placed, and where the word "input" appears we have some sort of a regulatable source of direct current voltage, by which we 1328
can, at will, make the grid there positive or negative by graduated means, that would be the set-up that is used in taking a characteristic curve, such as shown in Exhibit 24. You would ordinarily start by making the grid so negative, that no current reading was obtained in the instrument in the output circuit. A certain number of volts negative—we would draw, in preparation the horizontal and vertical co-ordinates, marking their junction zero, putting negative potentials at the scale on the left of zero and positive potentials of the grid at the right of 1329
zero, and then, if for example we made the grid 20 volts negative and found that there was no current flowing in the plate circuit, we would decrease the bias say, to 19 volts, and if we found a small current then at the scale reading for the 19 volts at the ordinate of the abscissua scale, we would indicate it by a dot, being the height or value of that curve by the height above the horizontal line, determined by a scale placed on the vertical co-ordinate or ordinate scale. So progressively we would decrease the voltage applied to the grid one volt at a time, and in each instance we would read the instru-

ment in the output circuit and put a dot, taking the height of that dot on the scale on a vertical line. As we proceeded, we would find that the increase of current per volt change on the grid in magnitude and as we reach the zero point, the succession of dots would indicate a rather steep line.

Then we would plot positive voltages to the grid and continue plotting these points indicat-
1331 ing the value of the current reading in the output circuit. All this is on the assumption that some particular value of the B battery shown in Exhibit 5 was being used and maintained constant. As we continue, we would find that eventually the current in the plate circuit ceased to increase.

We would then have obtained by connecting these dots with the smooth current, what is called a static characteristic of the tube for the particular value of the plate battery used. For further study of the performance of the tube,
1332 we could repeat the entire operation, using successively different values of the B battery, the plate battery, that is.

Referring to Exhibit 25, we have what is called a family of such curves—curve 1 being taken with a low plate battery, curve 2 with a larger one, and so on, curve 9 reaching the largest of the plate batteries.

Having thus charted the static characteristics of the tube, it would be possible to determine from them the so-called dynamic characteristic. The dynamic characteristic is a difficult concept to get, just as dynamic resistance or AC resistance of the tube in this patent No. 1,349,252,

we have those two related to one another, that is, the characteristics as shown in this family of curves, Exhibit 25, are all curved. There is no part of any of the characteristics that is really straight. That means the introduction of harmonic frequencies not contained in the original signal.

The patent 1,349,252, points out that if the load impedance is contained in the plate circuit that is equal to or greater than the internal 1334
dynamic or AC impedance of the tube, the characteristic curves would then be different.

In response to alternating current, the rise and fall of the plate current would not follow these characteristic curves, but would follow a dynamic curve, which is determined by the AC drop in voltage in the plate circuit, as the grid potential changes.

If we imagine that where the word "input" appears on Exhibit 5, there is some source of alternating voltage which is rapidly varying the voltage of the grid with respect to the filament, 1335
we are thereby causing in the plate circuit rapid variation of current in the output circuit.

That current flows through the impedance of the load device connected where the word "output" appears in Exhibit 5. The passing of the alternating current through that load impedance consumes a certain portion of the voltage available from the battery, and a continually varying portion of that voltage. The result is that the voltage actually appearing, if we were to measure it between the plate and the filament, is a varying voltage, always less than the voltage of the B battery by the amount of voltage that is

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consumed in sending the current through the load.

Therefore we can from a family of curves such as shown in Exhibit 25 plot a curve or a series of points which we can join up to constitute a curve, by assuming a definite variation of grid voltage to determine each point. For accurate plotting we should have many more curves in the family than shown in Exhibit 25. This, however, will serve for purposes of illustration. In the explanation which I gave in my direct examination I assumed that the normal bias applied to the grid by a biasing battery or other suitable means was such that in the absence of any signal coming in, and with a B battery whose voltage was equal to that of the curve 7, we had a current equal to that indicated at the point where the lines A and B cross the line 7. Dropping down a perpendicular onto the horizontal scale gives the grid voltage that I assumed.

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JOHN E. OTTERSON, called as a witness on behalf of the Plaintiffs in rebuttal, being duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is John Edward Otterson. I am president of Electrical Research Products, Inc. I have been president of Electrical Research Products five or six years. I was formerly employed by the Western Electric Company. I was

employed by the Western Electric Company in 1927 as commercial manager.

I have familiarized myself with the part of Mr. Schlesinger's testimony given here yesterday which relates to meetings with me. I do not agree with all of his statements. Referring to 1927, Mr. Schlesinger stated at page 387 of the record:

"We had several negotiations proposed, one in connection with talking motion picture equip- 1340
ment for foreign countries and others for talking motion pictures for South Africa generally, besides foreign; thirdly, a proposal to merge the patent situation that they contended they might have, as against those that I contended I had in the motion picture field."

And over on page 388:

"We talked about the motion picture business in America and the probability and desirability of having motion picture producers of silent pictures undertake to go into the new field. We talked about my entering into the field, and after 1341
I had entered into the field, I again talked to them and told them how I progressed in it." We had general conversations relating to those matters.

He continues: "I told them the equipment I was developing and my proposal to lease them, buy the goods in the open market and assemble them and then lease them to the theatres, and they asked me, 'What are you going to do about an amplifier?' I said, 'I would like to buy them from you.'" I had no such conversation.

The Court: Is this all with reference to 1927?

Mr. Ashton: That is what I understood, your Honor. It is not always clear.

The Witness: He also said, "They"—referring to me and Mr. Drake—"said that was rather a question; that they were using theirs for their own purposes; that the theatres were making a great demand for equipment; that they could not get the equipment fast enough for the growing industry, and I told them I had in
1343 1928, around the campaign, obtained one of their licensed amplifiers, and I could get a supply of them." I do not remember that.

Now on page 389 Mr. Schlesinger referred to a supply of amplifiers which he said he was obtaining, and said that he told me this: "I told him I was getting it from the American Transformer Company. I told Mr. Otterson that I was getting it from the American Transformer Company. He said to me, 'We are more concerned with the true reproduction obtained, so that the art is not impeded by the poor reproduction you
1344 get from bad sound.'" I made a statement to the effect that we were interested in seeing that the motion picture industry had good quality of sound; that that was our purpose. We were interested in that from the time that the Western Electric Company entered the sound field. It has always been our policy to direct our efforts toward the production of high quality of sound.

Beginning at the bottom of page 390, which is supposed to be with reference to the Fall of 1928, Mr. Schlesinger stated: "At that time I merely told Mr. Otterson that I was able to procure an American Transformer amplifier for

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the campaign, and was discussing with him the possibilities of the Western Electric selling me more amplifiers. * * * He said that he had known of the good work of the American Transformer amplifiers; he thought the amplifiers, as reported to him, were good amplifiers; that it was a licensed amplifier, from one of their licensees." I did not say that to him.

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He continues in response to this question, "Did he object to your purchasing and using it?" Mr. Schlesinger answered: "He did not." To the best of my recollection Mr. Schlesinger never informed me that he was buying amplifiers from the American Transformer Company, and we had no conversation at any time about the American Transformer Company.

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The Court: Mr. Ashton, if I am not mistaken, the witness Schlesinger said that in those conversations he discussed the South African theatres and the possible exchange of licenses, and explained what he was doing with his patents in America. Will you ask this witness if those subjects were discussed, if he recalls?

The Witness: Mr. Schlesinger brought up the question of South Africa. I took no position in regard to it.

Q. Did you ever consider acquiring any patents which were controlled by Mr. Schlesinger?

The Court: I will ask you to reframe that: Was that subject discussed between them?

1348 *John E. Otterson—For Plaintiffs—Rebuttal—Direct.*

Q. Was the subject of the acquisition of patents discussed with Mr. Schlesinger?

The Court: The exchange of licenses.

A. Mr. Schlesinger proposed it. We never agreed to it and had no disposition to agree to it.

The Court: But it was discussed?

The Witness: Yes.

1349

We had considered the De Forest and Ries patents prior to the formation of Electrical Research Products, the Patent Department.

Q. What had been their conclusion?

Mr. Darby: I object to that.

The Court: May I interrupt? I am not much interested in that now. I am interested in the subject of conversations.

Mr. Ashton: You asked about the negotiations, and I did not realize.

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The Court: What the witness thought and what they discussed are two different things.

By the Court:

Q. At any of those interviews did Mr. Schlesinger tell you what he was doing in the development of the patents that he said that he controlled in America? A. He told me that he was acquiring certain patent rights. He did not inform me in detail as to what they were. He stated that he was acquiring a very strong pat-

ent position that he believed was the basic control of the art.

Q. Do you agree that the conversations in which these latter matters were discussed took place in the Fall of 1928? A. About that time. I cannot place it exactly. It was during that period.

Q. So that the only respect in which your memory differs from that recited by the witness Schlesinger has to do with his reference to the 1352
American Transformer Company amplifiers? A. Well, as I read the testimony of yesterday it differed in other respects, your Honor.

By Mr. Ashton:

At page 397 Mr. Schlesinger testified in response to this question: "What did Mr. Otterson tell you about whether he had or had not any objection to your purchase and use of the 'Amer Tran' amplifier?" The answer was: "That he had spent endless time and money"—referring to me, of course—"in trying to educate 1353
the manufacturers of motion pictures in the silent field to enter upon the recording business in talking pictures, and that he was particularly interested that people would use the amplifiers that would reproduce properly and accurately, and the American Transformer Company, he told me, was one of those who made a high-class amplifier.

"Q. Did he object to your using it? A. He did not object to it. On the contrary, he encouraged us to use it."

We had no conversation about the American Transformer amplifier.

The Court: Your answer still refers to the Fall of 1928, does it, or to a later time?

Mr. Ashton: I should point out, your Honor, that this statement which I read was supposed to relate to February of 1929.

The Witness: The answer is the same.

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By the Court:

That is, that in February of 1929 there was no discussion between me and Mr. Schlesinger concerning his use of the American Transformer amplifiers.

By Mr. Ashton:

And he says that I stated to him before July, 1929, and apparently he meant after February: "'You go along, and competition is healthy, and as long as you make a good equipment I have no objection to it. * * * As long as you turn out a good equipment.'—which meant the taking of a good amplifier and the rest of our equipment." I did not make that statement to him.

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And he further said that I said, "as long as the royalty is paid it is quite all right." I made no such statement.

I recall no one by the name of Emanuel M. Zelony.

Mr. Zelony testified yesterday that I had a conversation with him some time in June, 1929, Mr. Zelony having stated that he was a sales

representative of the American Transformer Company. And he testified as follows:

"I told him that I represented the American Transformer Company and we were getting a lot of orders for amplifiers, and that we just wondered—when I said we, I referred as far as the American Transformer Company was concerned—whether we were all right in selling these amplifiers for the purpose of talking pictures. • • • Later on as we continued the 1358
conversation. Then we discussed other things and we wound up by saying—well, he said so far as he is concerned there is no objection, and the only objection that he told me that the other amplifier manufacturers on the market were selling cheap equipment, and that it spoiled some of their recordings, that the Western Electric had spent millions of dollars to improve, and that the cheaper product on the market really did not do them justice. There is lots of other things that were said."

And then he says: "'I told him I am selling 1359
amplifiers to General Talking Pictures as one of our customers, and I have sold others as well.

"Q. What did he say? A. He did not make a comment, except to indicate he understood so. He did not act surprised or anything. • • • He said that as far as he was concerned there was no objection."

I did not ever tell anybody that I had no objection. I have no recollection of anyone by the name of Zelony, and I had no conversation of this character with anyone connected with the American Transformer Company at any time. I would not have been in a position to approve

the manufacture and sale of talking motion picture amplifiers manufactured by other people at that time.

Mr. Berliner: I object to that, your Honor, as to whether he is in a position to approve.

Q. Why were you not?

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The Court: What have you to say to the objection?

Mr. Ashton: The point is that the Electrical Research Products and the Western Electric Company did not have at that time any rights which they could have extended of this nature.

Mr. Berliner: This agreement speaks for itself.

The Court: The question is whether he would have been in a position to approve. At that time I think the witness said he

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was in charge of the commercial relations of the Western Electric. Is that it?

Mr. Ashton: He was at the time of these conversations first in charge of the commercial products, and then when Electrical Research Products was formed he was president of that company.

The Court: I think we should distinguish between the time he was president of Electrical Research Products and the prior time. As to the prior time, would he be the proper witness to state what the scope of his authority was?

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Mr. Ashton: Yes, he would, your Honor, because he was immediately concerned with the very products which we are dealing here with, and in charge of the development of that commercial business.

The Court: Objection overruled, with exception.

Mr. Berliner: Exception.

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Q. Prior to the formation of Electrical Research Products, and while you were with the Western Electric Company could—

The Court: I think that you better ask him what his authority was, but do not ask him to construe it.

By Mr. Ashton:

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As to what was my authority with the Western Electric Company prior to the formation of Electrical Research Products, I was charged with the commercial development of the inventions of the Bell Telephone Laboratories, outside the telephone field and including the talking picture field. I had the same responsibilities as related to the talking picture field that I did subsequently as president of Electrical Research Products. Previous to the formation of Electrical Research Products the development of the talking picture field was handled as a departmental development of the Western Electric Company. Subsequently the duties and responsibilities that I had as head of that department were conveyed to the Electrical Research Products and I became its president.

1366 At that time, when I was with the Western Electric Company, in charge of these commercial matters, the Western Electric Company did not have any rights from the American Telephone Company, which would have permitted it to extend licenses to manufacturers of talking motion picture apparatus.

1367 Mr. Berliner: I object to that question, if your Honor please. He certainly is not competent to state that.

The Court: I think he is competent to state whether there was an arrangement by which the American Tel. & Tel. had the right to grant licenses. I think he is probably the one who was most familiar with the policy of the Western Electric Company in regard to that.

Mr. Darby: May I be heard, your Honor?

The Court: Surely.

1368 Mr. Darby: The right of any of these parties to grant licenses is by this pooling arrangement; that is the best evidence of it. All that we can get by that question is the opinion of this witness, which I submit is incompetent. The contract speaks for itself in that regard.

The Court: The method of administering that agreement may throw some light on it. I am not sure that it is binding on anybody, but I think the evidence is competent. Objection overruled and you may have an exception.

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By Mr. Ashton:

During the times in 1928 and 1929 when Mr. Schlesinger testified that he had conversations with me, Electrical Research Products did not have any rights under the patents of the Telephone Company which it could have extended to either the defendant or any other one manufacturing amplifiers.

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Mr. Berliner: We have the same objection, the same ruling and exception, your Honor?

The Court: Yes, the same ruling and exception.

Cross Examination by Mr. Darby:

I was made vice-president of Electrical Research Products about April 18, 1927; I don't recall the exact date. I was vested with all the authorities of a vice-president of the company at that time. It is my recollection that on December 19, 1927, I was elected president of Electrical Research Products, to be effective January 1, 1928, and from that time on I was vested with all the authority with which the president of a corporation is vested.

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I testified by affidavit in a proceeding in the United States District Court in Delaware entitled—or at least a series of proceedings—entitled, "Stanley Company of America, Inc., plaintiff, against American Telephone and Telegraph Company, Western Electric Company, Inc., and Electrical Research Products, Inc., de-

fendants," and Duovac Vacuum Tubes, Inc., against the same defendants, and the defendant in this suit, General Talking Pictures Corporation against the same defendants. All the statements I made in that affidavit were true.

Q. As I understand your testimony, you deny that you ever discussed with Mr. Schlesinger at any time the fact that the General Talking Pictures Corporation was using American Trans-
1373 former amplifiers, is that right? A. That is my recollection.

Q. You are quite positive on that? A. That is my recollection.

I cannot recall when I first knew that the General Talking Pictures Corporation were using American Transformer Company's amplifiers. It was later than 1928. I cannot say how much later it was; 1929, 1930 or 1931. Possibly it might even have been as late as 1931.

In my affidavit given in the Delaware litigation, verified October 21, 1932, I made the fol-
1374 lowing statement:

> "The Radio Corporation of America, an affiliate of the General Electric Company, which has operated in the field of sound recording and reproduction for motion picture purposes, was an actual competitor of the defendant Western and Vitaphone with respect to certain activities carried on by them and a potential competitor with respect to others, and since 1928 has been an actual competitor of the defendant Products in all of its activities in the motion picture field. These

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facts are well known to plaintiff in this action. Prior to the execution of the original license agreement between the defendant Western and Vitaphone, Warner Brothers desired that the licenses granted to Vitaphone should be exclusive licenses. In connection with their expressions to this effect, Warner Brothers were fully and carefully advised respecting the subject matter of the reciprocal license agreements and, in particular, that the rights of the defendant Western covering the recording and reproduction of sound for motion picture purposes were non-exclusive. The activities of the Radio Corporation and affiliated companies in the motion picture field have covered the production, distribution and exhibition of motion pictures with related sound, the manufacture and installation of sound recording and reproducing apparatus and the granting of licenses for the use of this apparatus by others. These activities have been the subject of common knowledge in the motion picture and connected industries.

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"Reference to the reciprocal license agreements is also made in the Warner Affidavit (Par. 4, pp. 7 and 8), and it is said with reference to the above mentioned contract of July 1, 1926, 'by said modification agreement the parties also pooled their patents covering the inventions relating to methods, systems and apparatus for the production and reproduction of talking motion pictures.' By this

comment, the affiant seems, as his language is read with the context, to insinuate that by the agreement referred to, the Telephone group of companies acquired exclusive rights 'relating to methods, systems and apparatus for the production and reproduction of talking motion pictures.' If such is the insinuation, it is wholly without basis in fact."

1379 Mr. Ashton: Just a moment, may I ask what is the point of this statement?

Mr. Darby: It has a vast number of points in this case and I am prepared to argue them out if it is necessary.

The Court: I think it is proper cross examination to call the witness' attention to the affidavit. I do not see the connection yet, but I suppose that is my fault.

Mr. Darby: Your Honor will soon see the connection, I am sure.

1380 The Witness: I made that statement and the statements therein made were true, to the best of my knowledge and belief at the time they were made; and they are still true today, to the best of my knowledge and belief.

Vitaphone Corporation is a subsidiary of Warner Brothers.

On page 67 of the same affidavit, I made the following statement:

"By the early autumn of 1928, I believe that the Radio Corporation of America, or one of its subsidiaries, had produced and made available to exhibitors repro-

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ducing equipments in limited numbers. By the latter part of the year, as had been anticipated in May, a number of other equipments were advertised and offered. Many of these equipments were utterly unfit for the showing of pictures with sound and most, if not all, were of decidedly inferior quality. During this period, I myself and other representatives and officers of the defendant Products, did 1382 urge our producer licensees, for the protection of themselves and in justice to the other licensees and to defendant Products, to refrain from releasing product to theatres equipped with apparatus incapable of rendering reasonably satisfactory reproduction."

The product referred to were motion picture films with sound.

And continuing the statement:

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"The producers had issued instructions to their salesmen not to arrange for the release of productions to theatres not equipped with apparatus furnished by the defendant Products unless the sound reproduction in such theatres was of good quality. Later, the producers became reluctant to rely upon the salesmen's judgment as to quality. They desired to arrive at some practicable and more dependable method by which they could, on the one hand, obtain as wide a market as possible for the productions, and, on the other

hand, avoid the risks which might be associated with releases to theatres not equipped for satisfactory sound reproduction."

That statement in its entirety, as you read it to me was true at the time I made the affidavit. And it is true to the best of my knowledge and belief at the present time. At the present time,
1385 the situation, of course, is different. The producers are not confronted with the problem to the same degree that they were then. The situation is different, but the statement is just as true as of that time, as it was when I made it, when I signed this affidavit.

Now, at that time, when talkies first became popular, I think it was true that the demand for reproducing equipment far exceeded our ability to supply it.

The statement in my affidavit continues:

1386 "The subject was discussed between representatives of the licensees and defendant Products; the objective of this discussion was not the obtaining of defendant Products' consent to indiscriminate distribution of pictures with sound, but to arrive at a plan which would be fair to the licensees, to defendant Products and to exhibitors, and at the same time protect the enterprise against the consequences of poor reproduction. This discussion took place in December of 1928. I verily believe that at no time, either before or after this date, was there any ex-

hibitor in whose theatre was installed reproducing equipment capable of rendering reasonably satisfactory performance, who was prevented from obtaining or had serious difficulty in obtaining, product of any of the licensees of the defendant Products."

That statement was correct. And there again the term "product" was used to designate motion picture film with sound; some was on film and some was on discs. 1388

On page 112 of the affidavit, I made this statement:

"The anticipation of defendant Products that inferior parts and devices would be manufactured and offered to exhibitors at prices less than those of defendant Products, has been fully realized. A great mass of so-called competitive product has been offered upon the market, most of 1389 which is inferior to that furnished by the defendant Products and much of which is utterly unsuited to installation in the reproducing equipments. Defendant Products, therefore, has continued the provisions originally incorporated in the leases of reproducing equipments by which the exhibitor is obligated to refrain from using, without the consent of defendant Products, parts and devices not furnished by Products.

"With the course of time, devices have been manufactured and placed on the mar-

ket by others than defendant Products which are suitable for use in the reproducing equipments. Some such parts are available to exhibitors at the present time. Products has expressly advised exhibitors that many of these parts are suitable for use in the reproducing equipment and affirmatively communicated its consent to the purchase of the same in the open

1391 market by exhibitors. Other parts in many instances have been purchased and used by exhibitors without express consent of defendant Products. This has been especially true with respect to the practice of Warner Brothers and the plaintiff. In none of these instances has Products attempted to enforce, through legal proceedings or threat thereof, any technical rights which the leases of reproducing equipments may be said to create.

"It is the purpose, policy and practice

1392 of the defendant Products to insist only that there shall be used in the reproducing equipments devices and parts free of patent complications and so designed and so manufactured that by the employment thereof the quality of performance of the apparatus as a whole shall not be impaired. It is my firm belief that the course followed by Products, as above described, has contributed substantially to the quality of sound pictures as presented to the public, and to the acceptance of this form of entertainment by motion picture audiences."

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I made that statement. The patent applications referred to in the last paragraph that was read from my statement, refers to the possibility of our licensed exhibitors using some equipment which might involve infringement of patents held by others. It also related to their use of apparatus infringing our apparatus.

Q. That is what you intended to convey by that? I will call something to your attention that might change your mind as to that last contention. I will not stop now on that because I want to pursue this thought for the moment. Under your agreement with the producers, you reserve expressly the right to take back the sound recording equipment of yours which was leased to the producer, if the producer distributed his film to a theatre for exhibition on a machine which did not give a quality of reproduction, which you considered to be equal to the quality of reproduction obtained with your own reproducing apparatus, did you not?

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Mr. Ashton: I object to that. He has already referred to the affidavit, and I would like to call your Honor's attention at this time to the fact that this cross examination is directed just about as much to another litigation as this one, if not more so. This case which was pending in Delaware, in which these same parties are involved, was an anti-trust case, and this examination seems to be directed almost entirely to that litigation.

The Court: I thought I detected a minute ago a possible connection between

the witness' deposition in this case and something that he said in that affidavit, but I am rather inclined to think that the interpretation of that affidavit is not pertinent. I think you may call the witness' attention to his statement in that affidavit and then if you care to contrast that statement with what he said here, I think you have a right to do that. I do think, however, that to go into a discourse as to the
1397 policy of his company in other matters may not be relevant, Mr. Darby.

Mr. Darby: On this particular question that is before the Court, I asked the witness if they did not reserve the right, which they did, and I think the witness will admit that, that in case the producer—

The Court: I heard the question and I tried to follow it.

Mr. Darby: Now, anticipating that the witness' answer is going to be in the affirmative, my next question is, did he ever
1398 exercise that right with respect to any producer who distributed films which were exhibited on sound reproduction equipment of the defendant, General Talking Pictures Corporation.

The Court: Suppose he answers that either way, what light will that throw on the specific object of the present inquiry which is whether he had certain conversations with Mr. Schlesinger or not?

Mr. Darby: There is a sharp issue of fact between the testimony of Mr. Schlesinger and Mr. Otterson.

The Court: It could not be much sharper.

Mr. Darby: It is categorical. Therefore it is necessary to resort to surrounding circumstances for what light it might throw on which is correct. One of the surrounding circumstances is this fact: This witness has said, and so has Mr. Schlesinger, that their primary purpose was quality and what-not. Therefore, if it is established, and I believe it is the fact, that no criticism has ever been directed to the quality of the American Transformer amplifier apparatus or General Talking Pictures apparatus, then I think your Honor will see the logical purport of the testimony. Now, as to this matter, a lot may be said on either side on the question of the weight to be given to the testimony, but I think it is certainly competent. 1399 1400

Mr. Ashton: May I point out, your Honor, that Mr. Darby is really now talking about another defense called "The Producer's License Defense" that is not pleaded in the answer in this case at all. It was pleaded in the Wallerstein case and was disposed of in this Wallerstein opinion, which you have here. 1401

Mr. Darby: You have misunderstood me.

Mr. Ashton: And I cannot see that it can have any bearing here, no matter what they may have done in that instance. This involved recording licensees and I want your Honor to understand they were not to manufacture apparatus, but to record sound and distribute film.

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The Court: I am going to attribute to Mr. Darby a desire to assist the Court in reaching a conclusion, and I am going to say that this line of inquiry will not help. I will sustain the objection.

Mr. Darby: May I note an exception?

The Court: Surely.

Mr. Darby: I do not want to press the matter beyond that point, but may I make

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a statement as to what I wanted to prove?

The Court: Certainly.

Mr. Darby: I wanted to prove by this witness in cross examination, that Electrical Research Products has never questioned the quality of American Transformer apparatus used in connection with reproduction of talking motion pictures.

The Court: I am willing that you should ask him that.

By Mr. Darby:

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We have in our own internal discussions questioned the quality of the operation of the American Transformer amplifying apparatus used in connection with reproduction of talking motion pictures. Whether we have ever served any formal notice on anyone to that effect, I don't know. As far as my personal knowledge is concerned, I have no recollection of ever having done so. It may have been done on the part of our legal or patent department or someone else in the organization besides myself. Personally, I have no recollection. I do not know that it has ever been done.

In my discussion with Mr. Schlesinger, I believe I stated that I did recall that Mr. Schlesinger told me that he was acquiring patent rights. I suppose they could be described as the DeForest patents. He told me at that time that they were the DeForest patent rights. They were DeForest patents for the purpose of recording the sound-on-film. I think Mr. Schlesinger told me both that he was acquiring those patents and that he had acquired those patents. My recollection is that he told me he was negotiating for them and subsequently that he had acquired them.

I was familiar with the subject matter of those patents at that time. I told Mr. Schlesinger at that time that we claimed a license under the DeForest patent. I knew that the General Talking Pictures Company had reproducing equipment in the field after they acquired the patents. I do not recall that I had any knowledge of their having anything in the field before they acquired the patents.

Q. But you knew they had some reproducing equipment in the field after they acquired the patents at this second conference that you referred to in the discussion with Mr. Schlesinger?

A. I don't know whether it was the second conference. At a later conference, I had knowledge of it.

I knew that that equipment in the field employed amplifying apparatus. I knew that the equipment of the General Talking Pictures was being used in reproducing the same films that our licensed exhibitors were reproducing.

Q. As a matter of fact, you knew just exactly

what the system employed by the General Talking Pictures was, didn't you?

Mr. Ashton: When was this, Mr. Darby?

The Court: This was after the interview.

A. Well, I cannot say that I personally knew exactly what it was, no. It was known to our
1409 organization. I knew that the equipment employed amplifiers. I knew that they were vacuum tube amplifiers. I don't know at what time I knew by whom the amplifiers were manufactured; it was later.

Q. How did you understand that people in your organization gained information as to what equipment the General Talking Pictures Corporation employed?

Mr. Ashton: Mr. Darby, I will object
1410 to that. And I will say that we have already stated that the first information the patent department had was in April, 1929, and I believe you will—

Mr. Darby: Just a minute, this is cross examination. May I have the privilege of stating that if there is an objection to the question that counsel just state the objection without making any other statement.

Mr. Ashton: I object to the question. This witness has already testified it was later on—

Mr. Darby: Just a minute, please. I submit he should state his objection and the ground, without making any further statements.

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The Court: Yes, I think you better follow the practice.

Mr. Ashton: I object to the question on the ground that the witness has already stated—

Mr. Darby: That is argument.

The Court: What is there that is objectionable to the question?

Mr. Darby: Is it irrelevant or immaterial, what is your basis for the objection?

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Mr. Ashton: My objection to the question, your Honor, is that this witness has already testified that it was later on.

The Court: I don't think that is a proper objection; it is overruled and exception.

Mr. Darby: Will you please read the question?

(Question read.)

Q. Was it by an inspection of the apparatus?

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Mr. Ashton: Will you please let him answer the question before you suggest an answer?

The Witness: I assume that it was by an inspection of the apparatus. I don't know whether they had other means or not.

I have no recollection of Mr. Schlesinger ever having told me that he was employing Amer Tran amplifiers. I deny that he ever told me that to the extent that I have no recollection of it. I have no record of it in my files, of his

making any such statement. My testimony is based exclusively on what is contained in my files and my own recollection.

I never offered to buy any General Talking Pictures equipment from Mr. Schlesinger or the General Talking Pictures Corporation. I did not offer $300,000 for 300 General Talking Pictures reproducing machines. I am sure of that. I never offered Mr. Schlesinger to buy out Mr.
1415 Schlesinger or the General Talking Pictures Company.

The Court: Just a moment, Mr. Darby. Will you please ask the witness if he had any familiarity with the royalty returns made by the American Transformer Company?

By Mr. Darby:

Answering the Court's question, I had no
1416 knowledge. I did not personally take any steps to find out. Whether our legal or patent department did, I cannot say. I have no knowledge of their having done so.

Q. As a matter of fact, under the pooling arrangement of the patent rights of the American Telephone and Telegraph Company, and Western Electric Company, the Radio Corporation of America and the General Electric Company, the Radio Corporation was put in managerial control of the license system, was it not?

Mr. Ashton: I think the agreement speaks for itself, your Honor.

The Court: I think you asked the witness a few questions on the license agreement matter and I think the other side might have the same privilege.

Q. Do you understand the question?

The Witness: May I have the question? (Question read.)

Mr. Ashton: I would like to point out, your Honor, that these are different agreements from the ones we referred to before. These agreements that had to do with the Amer Tran license and not between the Telephone Company and Electrical Research Products. 1418

The Court: I will confide to you, Mr. Ashton, that I would like to hear an answer to that question.

Mr. Ashton: That is all right, your Honor.

The Witness: I think I would like to have an answer to it myself. It is a rather involved question. 1419

By Mr. Darby:

I know of the patent pool agreements between the General Electric Company, the American Tel. and Tel. and Western Electric Company and others.

I know that under the pool of patents, certain licenses were granted by the Radio Corporation of America.

Q. Now, you know under the pooling arrange-

ment, the Radio Corporation of America was put in managerial control of the licenses which were granted by the Radio Corporation and its affiliated companies, do you not? A. They were not in control of any royalties payable to us—any managerial control.

Q. I understand that, but they were in managerial control with regard to collection of all royalties that were to be paid under the licenses,
1421 which the Radio Corporation granted, with the consent, approval and joinder of the other members of the pool? A. They were in managerial control of the royalties which they collected under licenses, collected by them under the cross license agreement.

When I say licenses granted by them, I mean to include those licenses in which the Telephone Company likewise joined with the RCA as a licensor.

Where the RCA granted the licenses, they had the responsibilities of collecting the royalties.
1422 But there was no pooling as to the royalties. There was no division of the royalties between them. When you say managerial control, it did not relate to the two parties to the cross licensing agreement. They had managerial control of their own business, not ours. And our business, as far as granting patent rights and licenses are concerned.

Re-direct Examination by Mr. Ashton:

These recording licenses referred to in my statement read to me by Mr. Darby were talking motion picture recording licenses.

HARRY G. KNOX, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Harry G. Knox, I am vice-president of Electrical Research Products, Inc. I have been connected with Electrical Research Products and the Western Electric Company since 1927. 1424

Mr. Schlesinger stated yesterday that I made a statement, implied in my answer as follows: page 389 of the minutes,

> "I am just trying to recollect the incidents, they came so fast and furious in those days, and it is so far back. I am trying to do the best I can. Well, particularly after my return from a European trip, and about the time that Mr. Knox, another of the officials of the Western Electric Company or Electrical Research Products Corporation was about leaving for England, Mr. Knox called on me at my office and we had a talk about the amplifier that I was using, and he said, 'You are lucky to have a licensed amplifier'." 1425

I do not recall making that statement to Mr. Schlesinger at any time.

The Court: Will you just wait a minute. What was the date of that conversation,

Mr. Ashton, please? Do the minutes disclose the date of the conversation between Mr. Schlesinger and Mr. Knox?

Mr. Ashton: The reference which I have, that is the reference at page 387 where it says it was 1927, then below this part that I just read to Mr. Knox on page 389 it apparently is 1929. That was the reason I was not definite in my question regard-
1427 ing it. It was not clear to me.

The Court: Just what was the question, read it to me, please.

(Question read.)

By the Court:

I remember calling at Mr. Schlesinger's office either before I went to Europe in 1927 or after I returned in 1929. I cannot state the date. I think I returned in September, 1929.

I recall vaguely the conversation that took
1428 place when I made that call. I was the European manager for Electrical Research Products, when I was abroad, and in that capacity, was interested in the potential territory of South Africa, in which country Mr. Schlesinger was influential and owned or controlled a number of motion picture theatres, which I thought might be potential users of our reproducing equipment. I think he also discussed the patent situation as regards Europe.

The availability of our equipment for use in South Africa was the primary object of it. That is what we talked about. I do not remember that we talked about his use of the American Trans-

former amplifier at all. We might have. It is entirely possible.

By Mr. Ashton:

I do not think that the solicitation of business on our part for our reproducing apparatus for South Africa had any relation with what Mr. Schlesinger may have been doing in the United States.

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Cross Examination by Mr. Darby:

Q. You also saw Mr. Schlesinger in London, didn't you? A. I think so, yes.

Q. And you knew, did you not, that Mr. Schlesinger had talking motion picture equipment which was being used or put out under the name of General Talking Pictures? A. Yes.

Q. And you knew that that apparatus employed amplifiers of the American Transformer Company, didn't you? A. Not necessarily American Transformer Company. I knew that he did not manufacture amplifiers, but I do not think I knew where he got them unless he told me so, and I do not recall that.

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FRANK N. WATERMAN, resumed the stand.

Direct Examination by Mr. Ashton (Continued):

Q. Will you continue, please. A. If now we assume that a signal is received on the grid

which is such as to decrease the negative potential—in other words, the signal moves the bias or the instantaneous potential of the grid to the right from the point just indicated—then if the voltage on the plate of the tube remain that indicated by the curve 7, the current would rise following that curve, say to a point opposite the number 7 for a voltage indicated on the horizontal scale by the point perpendicularly below.

1433 But as soon as the current started to rise there would be an absorption of voltage in the load, so that instead of rising on the curve 7 it would, for instance, arrive only at the point on the curve 6 immediately under the point on the curve 7 which it otherwise would have reached.

It would therefore in effect have followed the dotted line marked a instead of following the curve 7; because when the current rose by a certain small increment there would be at first absorption of voltage, and therefore reduction of the actual voltage experienced by the plate. So

1434 as the current increased with the reduction of the negative bias, it would for a given plate circuit impedance have followed the curve a; and, by the same process, we could develop the curve a as far to the right as we chose.

Similarly, if the signal applied to the grid were such as to increase the negative potential upon the grid by a corresponding amount, the current would if the potential of the curve 7 was maintained, have fallen on that curve. However, when the current falls the potential consumed in the external circuit is reduced; therefore, the potential which actually reaches the plate is increased, and therefore as the grid became more

and more negative the current instead of falling as rapidly as called for by the curve 7 would travel down the dotted line of the curve a and eventually a current value would be reached correspondent to a point on the curve a. Dropping a perpendicular from that point onto the horizontal line we find the grid voltage at which that would occur.

The effect of these changes in effective plate voltage as the result of the alternating current 1436
plate circuit impedance, the external circuit, is to straighten the characteristic; that is to say, it takes out the curvature to a greater or less extent, and if the external impedance is high enough with relation to the internal alternating current impedance of the tube the curve becomes practically a straight line over a large region. The actual useful range of the tube for the reception of signal is increased; at the same time the possibilities of distortion due to the introduction of harmonics is decreased.

Q. Will you state, Mr. Waterman, whether you 1437
find the invention of this patent in the preceding patent, that is the 1,329,283, patent, on the question of double patenting? A. No, the patent 1,329,283, makes no disclosure whatever as to the effect of external load upon the shape of the characteristic. It goes wholly to the question of power output when the circuit and tube are organized in a certain way as set forth in the claims.

Q. Will you take up as briefly as you can the several patents which were relied upon against this Arnold patent, starting with 1,114,845, Tab 8? If it will help you any I will give you the list

right now. A. If you would give me one at a time it would be just as well.

Q. Then take Patent 1,114,845. A. Patent 1,114,845, to Arnold is what is known in the vernacular of the art as a blue glow preventer.

Q. The same thing that is meant by blue haze? A. Blue haze, yes.

By the Court:

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Q. That has to do with the action of the electron? A. It has to do with the setting up of a state of permanent ionization, the first ionization, by collision as it is called. The electrons knock off other electrons from atoms of gas in the tube.

By Mr. Ashton:

Q. It is a gassy tube? A. A gassy tube. The early tubes were mostly gassy. When the ionization by collision has proceeded to a sufficient extent the electrons given off by atoms in the gas become sufficiently numerous to disrupt other atoms, and so the process, so to speak, becomes contagious and self-perpetuating. Then the tube is filled with a blue haze or glow and ceases to function. The condition in which the audion ceases to function is the condition in which the Von Lieben tube that we have been discussing normally functions. That condition may be brought about by an abnormally strong signal applied to the grid, by a change of brilliance of the filament, by a change of plate voltage. When those things are constant it usually comes about

1440

by reason of the strength of the signal, or sometimes merely getting one's hand close to the tube. Since the tube instantly goes out of action when that occurs, it is desirable that it should be interrupted as soon as possible. One well known way of doing that was to reduce the plate voltage, and in the detectors of those days when I was working with these tubes it was customary to have a switch whereby the number of batteries in the plate circuit could be quickly varied, 1442
and if the blue glow appeared throwing the switch to a lower battery voltage would cause it to cease, and in receiving messages, which in my reception in those days was the only thing there was to receive, and telegraphic signals, we would lose a letter in a message while that was happening, at least.

The Arnold patent inserts a resistance 8 into the plate circuit. The purpose of that resistance is this, if I may refer to the characteristic curve of Exhibit 24 to illustrate what I mean. The normal change of grid potential on this curve, 1443
equal to, say, an eighth of an inch, would give rise to a change of current equal to the corresponding ordinate, which is 3/16ths perhaps; but if this condition of blue glow occurs, the current no longer followed that curve but shot straight up. That current flowing through the resistance 8 caused the absorption of a large voltage. The actual voltage on the plate was reduced and the ionization died out. Therefore this resistance was able to automatically discontinue the blue haze. The action is not instantaneous, but it is rather quicker than one can manipulate a switch.

In order that that resistance should not affect the signal, however, it is shunted by a condenser 9, so that the alternating current passes through 9 chiefly, and then through the transformer 6. Therefore, so far as the normal functioning of the tube is concerned the resistance 8 is not there. But when the blue haze appears and with it the sudden great rise of current, that being a direct current flow, it chiefly traverses resist-
1445 ance 8. Insofar as it is purely direct current it wholly traverses 8; only a transient effect is experienced by the condenser 9. I think we need not go into the question of what transient effects are.

Therefore the circuit normally performs as though no resistance 8 were there, and for the purpose of the signal the resistance 8 has no characteristic straightening effect whatever.

By the Court:

1446 Q. How does the resistance 8 learn that it is called upon to function? A. The resistance 8 is a part of the direct current circuit. The direct current is always flowing through the primary coil of transformer 6 to the resistance 8, through the plate across the tube and back to its source. When the resistance in the tube is decreased, then a larger part of the total battery voltage exists across the transformer primary and across the resistance. That gives rise to a large current.

The easiest way to look at those things, your Honor, is to recognize that the battery 7 creates a difference of potential, 50 volts let us say. A current starts out from the battery at a voltage

of 50 volts, with reference to the negative end. By the time it gets back that 50 volts is all gone. Some of it has been lost, only a small part probably in the primary of the transformer 6, some of it has been lost in the resistance 8, the rest has been expended in creating the space current in the tube, that is, in pulling the electrons across. If now, due to the creation of a large number of positive ions as the result of knocking electrons out of the atoms, the tube resistance is greatly 1448
decreased, say to one-tenth or one one-hundredth what it was before, then a much larger current must flow in order that that same 50 volts we assume on the battery may be consumed. That will mean a rise of current all through the circuit, an increased loss of voltage in the resistance 8, therefore a reduced voltage, a reduced electron velocity, in the tube itself, and a dying out of the state of ionization.

The alternating current flowing from the plate let us say through the circuit comes to the division point between resistance 8 and a con- 1449
denser 9. It is going to take the easiest path. If it should by any chance make a mistake and choose the resistance, that current which had by accident gone through 9 would come out with a higher voltage at the junction point, and that is impossible. The same point cannot have two different voltages. Therefore what the alternating current does is to go through the condenser primarily, and only enough alternating current is sidetracked around through 8 so that the voltage at the two ends of that parallel net mesh have the same voltage. That means that a very small part will go through 8 and a large part

through 9, if the resistance 8 is large as compared to the impedance at 9.

Q. When it comes out of 9 it is partially direct, isn't it? It has been partly converted into direct, hasn't it? A. No, the alternating current never changes its character.

Q. It still has alternating pulsations, but the ripples are smoothed out, aren't they? A. No, I think not, your Honor. Insofar as there has been
1451 some loss of voltage in the condenser 9 the ripples are less high than they were before; they have been smoothed out in that sense, but they have not been changed in character.

Q. It becomes uni-directional, doesn't it? Isn't that the office of it? A. No, the alternating current goes through in either direction perfectly well.

Mr. Ashton: It is not a rectifier, your Honor.

1452 The Witness: No, it has no rectifying effect whatever. The tube itself is uni-directional in its carrying capacity; that is to say, using conventional terminology, current in the tube can only pass from the plate to the filament, and not in the reverse direction. That is why it is necessary to have flowing through the tube all the time a direct current, so that the alternating current coming out is really in effect only represented by an increase and a decrease of a direct current. The actual current through the tube is the same. But when we come to the transformer, the direct current will have no effect in the secondary transformer, but every variation of it, that is all

of its alternating current part, will reproduce itself in the secondary of the transformer, and the transformer therefore serves to separate the direct current from the alternating current in the plate circuit. That is one of the proofs that we are correct in looking upon the varied direct current as a constant direct current plus a varying alternating current.

I perhaps ought to refer to Fig. 3, although I do not remember that Mr. Cloud did. In that 1454
instance the resistance 8 is used as part of the parallel feed, and the alternating current path is through the condenser 12, the upper condenser 12, through the primary of transformer 6 and the lower condenser 12. In this instance the resistance could not in any event have any effect upon the characteristic, because it is in a parallel circuit. The only effect which it has is to reduce the impedance of the load circuit. If the resistance 8 were infinite it would have no effect whatever; being finite, the larger it is the less effect it has. Therefore in no case could a re- 1455
sistance located as in Fig. 3 have the resistance straightening effect. That is true of both, parallel to each circuit.

By Mr. Ashton:

Q. Now the Pierce Patent 1,127,371. That is a patent, is it not, which takes advantage of the gas in it and the unstable characteristic which results? A. That is certainly true as to Fig. 1. I believe it is intended to be true also as to Fig. 2, because the patent states on page 1, line 20, that the apparatus is that illustrated and de-

scribed in the preceding patents, and goes on to say "apparatus for amplifying or detecting electrical variations, a body of gas in an evacuated tube is maintained in a sensitive conducting condition, by means of an ionizing agency such as a hot filament or the mercury arc." The mercury arc produces the positive and negative ions and is a state of self-perpetuating ionization. The tube of Fig. 1 maintains a continuous arc.

1457 As I understand the specification the same method of operation is set forth for Fig. 2 as for Fig. 1. In Fig. 1 we have a mercury arc formed between the cathode 6, which is a pool of mercury, and the anode 5, and it is connected in a characterisctic arc circuit. A source indicated as a battery A supplies current through an inductance, and the resistance to the anode, and the current flows thence across the space and makes the travelling bubble that we are probably all familiar with in these mercury tubes. That combination of unlettered inductance and re-

1458 sistance is known as ballast, and it is necessary to keep the arc from running away.

The arc goes through a peculiar cycle. The current rises as the voltage is increased. Then suddenly a change takes place and the current rises while the voltage across the arc decreases. That is an uncontrollable state, unless there is in the external circuit a ballast, and that consists of two things, a resistance which is what is known as a dead resistance, and an inductance which is what is known as a live resistance and which operates by virtue of its stored energy. Those enable the arc to be controlled at some desired point.

What Dr. Pierce does is to rob that space of some of its ions and cause them to flow in a circuit including the anode 2 at the top of the tube, and they constitute a current flowing through the wire 30, the resistance 39, the relay 51, the telephone 40, the relay 32 back to the battery, the circuit being completed by the wire to the left of the battery, and up through the mercury column in the spacing of the tube. That stream he controls by a grid device 3 in response to radio fre- 1460
quency signals coming in by way of the antenna 20 and the transformer 22, 23. As they come in they pass through the condenser 27 and are rectified in the tube, because this tube also conducts only one way, leaving the condenser charged.

Two things representing opposite extremes in that operation may happen. In the first place the arc or the stream established, stream of positive ions established in the path between the anode 2 and the mercury pool 6, may itself follow the curve with this peculiar course which I have indicated, and if the current gets past that criti- 1461
cal point it would result in blowing up the whole apparatus. The current would go to uncontrolled heights and the tube would explode. Therefore he has a ballast in that circuit 2 also; namely, in the circuit connecting anode 2 to the battery by wire 30, and the relays and telephone, that ballast is 39.

Referring to page 2, line 47, it is stated, "the circuit 30 may be provided with a ballast resistance 39." The reason why it only "may be" is that the resistance and inductance in the circuit may of themselves be sufficient ballast, but

if not then resistance enough to prevent the destructive running away of the arc is included.

The same description applies to Fig. 2, as I understand it, except that there is not the extreme danger of explosion in that case that there is in the other. There would be, however, a complete inoperativeness if the current got to the runaway part, and therefore a ballast 39 is shown in that case. This has to do merely with
1463 the reception of telegraph signals. The straight line characteristic is of no consequence, it would not be recognized if it existed; and as a matter of fact the ballast resistance required would not ordinarily be at all comparable with the internal resistance of the tube. It is in fact relatively small. There are very definite rules for working that out, but in general a ballast resistance is not at all the same thing as a characteristic straightening resistance.

"Q. Does the operation of the patent depend upon the change of the tube from stable to un-
1464 stable operating condition? A. Yes. I neglected to state the other extreme that I believe Mr. Cloud did refer to, resistance 62 also, and I perhaps ought to state that. If a very heavy signal comes into a tube of this sort it may put so large a charge upon the grid as to cut off all flow of current or to reduce it to a prohibitively low point. If the condenser 27, for example, acquired such a charge and cut off the flow, then the receipt of the signal would be interrupted. I should point out to your Honor that the relay 32 works through a local battery, a sounder 34, so that the operator reads the signal by the ordinary click-

ing sounder, such as we are accustomed to hear in telegraphic offices; or in the event that the dots and dashes should not be sufficiently strong to operate the sounder, the operator may put on the headphone 40 and read them by sound.

The patent states, referring to page 1, line 51:

> "It is found, however, that when the apparatus is adjusted so that it will be sensitive to feebly received oscillations if 1466
> stronger oscillations are impressed on the controlling circuit there will be an appreciable time lag before the tube recovers its normal conductivity."

In other words, the current is chased down on the curve of the tube, whether it is this shape or not—chased down toward the cut-off point.

> "This is believed to be due to an accumulation of a sufficiently great negative charge on the screen and condenser caused 1467
> by the rectification of the impressed oscillations, so that the charge is not dissipated from the screen for an appreciable time."

By the Court:

Q. Does he mean grid, "screen"? A. Yes, he mean grid. Therefore he includes in the circuit a relay 51, in the plate circuit, which is held attracted by the magnet of the relay when the current is of a desired normal intensity. If the current is reduced too low or altogether cancelled out by the negative charge received on the

condenser, it releases its armature and makes a back contact.

In Fig. 1 the back contact merely short-circuits the condenser 27, thereby relieving it of its charge. In the case of Fig. 2 it shunts it by a voltage derived from the battery 61, so that instead of being returned to a zero voltage it is returned to any desired voltage. The passage which I just quoted refers to adjusting of the
1469 tube to feeble oscillations. That used to be done in the case of tubes such as in Fig. 2 by the temperature of the filament very largely, and the tube could be brought to a state where a signal coming in would momentarily drive the curve up on this rise, and yet it would come back again, the rise being not actually vertical but sloping into a vertical. For the reception of feeble signals that was the most sensitive condition under which you could work. It was very critical. That is what Dr. Pierce means when he says "adjusted sensitive to feeble oscillations." Then if a
1470 stronger oscillation comes in, it could have one of two effects, whichever it reached first. It could shoot the current up on the curve of gas action or it could plug the condenser. Whichever happened first would get control. Therefore he controls both ways.

By Mr. Ashton:

Q. In this next patent 1,129,943, Tab 11, it is true as Mr. Cloud admitted, I believe, that the resistances 8 in both figures are coupling resistances, is it not? A. That is true.

Q. Is there any disclosure as to the resistance

of the tubes in this patent? Might they be high voltage tubes? A. They are indicated as high voltage tubes. I have been assuming all the time that they were high voltage tubes.

Q. If they are high voltage tubes may their resistances be as much as several hundred thousand ohms? A. Oh, yes.

Q. Now will you refer to the Colpitts Patent 1,137,384, tab 13. As I understand it this is a modulator, is it not? A. It is a combined generator and modulator. It relates to the transmission of signal, and in each case the tube is used in the double capacity of generator of high frequency oscillation and modulator thereof. That means the necessity for critical adjustments. If I recall correctly Mr. Cloud referred chiefly to Fig. 2 and to a symbol therein appearing immediately at the right of the condenser 8 in that figure. This he called a resistance. However, it is not described as a resistance and it is shown in the same way as the coils. In other words, the patentee here does not discriminate in his symbolism between parts which he describes as resistance and parts which he describes as coils.

The natural thing to expect of Fig. 2 is that the symbol at the right of the condenser is an inductance and that together with the variable condenser 8 it constitutes a tuning inductance. To make that clear would involve perhaps a rather long explanation, but I may perhaps short-cut it in this way: a tube will act as a generator of oscillations if an amplified oscillation in its plate circuit is carried back and put into the grid circuit again. In other words, let us assume that something or other gives a

1474 change of voltage to the grid 13 in Fig. 1, taking that as being the simplest figure. That impulse, whatever it was, will appear in exaggerated form in the coil 4 in the plate circuit of that tube. 4 is the primary of an oscillation transformer, meaning a high frequency transformer 6. That exaggerated impulse in 4 is repeated in 17, and from 17 it is carried back through condenser 18 to the grid 13, but acting on the grid
1475 it in turn creates a still more exaggerated impulse in the plate circuit because every impulse on the grid creates an impulse on the plate circuit.

By the Court:

Q. That is the office of the grid, is it? A. That is the office of the grid. So that that doubly exaggerated impulse again passes through the coil 4 and is again fed back to the grid. The result is that that process continues until the tube
1476 assumes a continuous state of oscillation. The question is what frequency will that oscillation have, desired to control it? That must be done by tuning a certain element; that is, by giving to some element a definite time period. Does your Honor understand what I mean by "tuning"?

Q. No, I do not think I do. A. Your Honor is acquainted with the fact that in mechanics a combination of a weight and a spring will oscillate at a given period. An inductance electrically corresponds to a weight. You can write the mechanical and electrical equations in parallel columns and they will be exactly alike. The

terms of one represent mass or weight and of the other will represent inductance. Capacity corresponds to a spring, the term which represents elasticity in a mechanical equation will represent capacity in an electrical equation. So if you combine inductance and capacity you have a system which will have the same strong preference for oscillation at a given frequency that a combination weight and spring has, as in the balance wheel of your watch. So all tuning in 1478
radio is done by determining in one way or another correct or desired relations of inductance and capacity.

In Fig. 1 the condensers 8, 9 are variable, and they are tuning elements. That is rather imperfect. It is a very simple system, but rather an imperfect one. He goes on to make them more perfect in other figures. In Fig. 2, as I interpreted, he has that condenser 8 and a variable inductance along with it for his tuning.

Q. By tuning you might roughly say adjusting? A. Yes. He does exactly the same thing 1479
when you adjust the regulator of your watch, adjust the time period swing. The modulation is effected by simultaneously impressing on the input circuit the alternating current derived from a microphone. In Fig. 1 that is completely illustrated. It is only indicated in the other figures. The microphone is at 24. It is supplied by its local battery 23 speaking into the microphone, which superimposes an alternating current on the normal current flowing through the microphone. That alternating current is transformed in condenser 32 over into the secondary circuit coil 20, and passed on to the input trans-

former 15 from whose secondary 14 it passes to the grid. Therefore the tube is doing two things at once: it is oscillating, producing an oscillatory current; it is modifying that oscillatory current in accordance with the relatively slow changes due to the speech curves. The radio frequencies may be of the order of hundreds of thousands per second, whereas the speech frequency at the most are in the lower thousands.

1481 It is necessary that the apparatus should be very thoroughly adjustable in order that these generated alternating currents and the modulating audio current should be in correct relation to one another, and that accounts for the large number of adjustments that one finds in all these figures except Fig. 1. Fig. 1 is really just for the purpose of explaining what it is all about. The other figures show the numerous adjustments that are involved in getting those of the right relative magnitudes and of the right oscillation frequency.

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AFTERNOON SESSION.

HERBERT M. WILCOX, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Herbert M. Wilcox. I am vice-president of Electrical Research Products, Inc.

Electrical Research Products Company was incorporated on December 20, 1926. It was formed to commercially promote the use of the patents of the telephone industry in the commercial field, more particularly the Western Electric system of recording and reproducing sound for talking motion pictures. When I said "patents" a moment ago I meant patents. I meant developing patents.

An exhibition of Western Electric talking motion pictures occurred on August 6, 1926, in New York. It was very successful. It aroused widespread interest in the motion picture industry, and within two years, talking pictures were generally adopted by the industry as a whole. 1484

I don't believe there were any theatres anywhere equipped with commercial apparatus enabling them regularly to show talking motion pictures with such apparatus at the time the Western Electric Company's apparatus was introduced to the public in August, 1926. I am not familiar with any. I knew of none. I would probably have known if there were any. Other companies had attempted to introduce talking pictures prior to that time. I believe Lee DeForest and DeForest Fonofilm had attempted to introduce them prior to that time. They had not been done in a commercially successful way. I am not aware that any motion picture producer, except Vitaphone, or prior to Vitaphone regularly produced and distributed talking motion pictures, prior to the introduction of the Western Electric system. The Vitaphone Corporation acquired its recording license from the 1485

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Western Electric Company April 20, 1926. The Vitaphone Corporation granted a sub-license to the Fox Case Company, a subsidiary of the Fox Film Company, in December, 1926.

Electrical Research Products granted five recording licenses in May, 1928; Famous Players-Lasky Corporation; Metro-Goldwyn-Mayer; United Artists; Universal Pictures; and Firmatone Corporation, which was a subsidiary of

1487

First National Pictures.

An investigation was made by these producers before they took their licenses. A committee was formed to investigate various makes and types of sound recording and reproducing apparatus, which worked for nearly a year, I believe, and finally decided to adopt the Western Electric system. There was other apparatus which was being offered at that time in 1928. This is a correct list of the present recording licensees in the United States and foreign countries of Western Electric sound system.

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Mr. Ashton: I ask that the list be copied into the record at this point.

Mr. Darby: How is it pertinent or relevant?

Mr. Ashton: We want a record of the licensees of the Western Electric Company for the purpose of showing the use of Western Electric system, which embodies the inventions here in suit.

The Court: Is this a list of licensees prior to the date of the filing of the bill?

Mr. Ashton: I do not know whether

that would require any change or not; most of these licensees continued from the time they first acquired their licenses. Maybe Mr. Wilcox could tell me, I don't know whether he could offhand, what differences there are in the list since September, 1929.

The Witness: I could not offhand, but there have been some substantial additions to it since that time. 1490

Mr. Darby: For the purpose of showing use, I do not think it is pertinent or necessary, but at any rate it should only include those before the filing of the bill. Even those prior to the date of the filing of the bill I do not see that it is relevant or material to any issue in this case.

The Court: I am not able to say that it would be and I am unable to say that it would not be. Do you want that copied into the record as of September, 1929?

Mr. Ashton: As of the present time, unless I misunderstood your Honor's ruling. 1491

The Court: Is there an objection?

Mr. Darby: Yes, I objected and I understood your Honor overruled my objection and allowed me an exception. That was for any purpose whatever. As to those that were licensed prior to the filing of the bill, I of course adhere to the objection, and to anything subsequent to that time, but I do not see any necessity for delaying the proceedings, if Mr.

Ashton will undertake to see that a correct list, corrected to date, is supplied to the stenographer.

Mr. Ashton: I would be glad to supply that if your Honor rules those are the only ones that may go in.

The Court: I do not see that the present list of licensees is pertinent, but if I am wrong in that, I would like to be informed.

1493 Mr. Ashton: That is merely to show, your Honor, the extent to which these inventions are used, so it is pertinent to show what concerns have licenses now.

Mr. Darby: My point is this: There is evidence in the case now that these inventions—or the inventions of these various patents have been used for transcontinental telephony, for transoceanic telephony, and we have at no time questioned the utility of the invention, and this is merely cumulative evidence on something

1494 that is not in issue or in dispute. I do not see that it is material at all.

Mr. Ashton: The particular use to which the suit is directed is talking motion picture use. I do not think, so far as the bill of complaint is concerned, that the other uses enter into the question of admissibility of the list.

The Court: I will overrule the objection and exception.

(The list referred to is as follows):

LIST OF TALKING MOTION PICTURE RECORDING LICENSEES OF ELECTRICAL RESEARCH PRODUCTS, INC.

United States

Audio-Cinema, Inc.
Audio Products, Inc.
Cinelog Corporation
Columbia Pictures Corporation
Eastern Service Studios, Inc.
Firnatone Corporation 1496
Fox Film Corporation
General Service Studios, Inc.
Movietonews, Inc.
Hal Roach Studios, Inc.
Metro-Goldwyn Pictures Corporation
Paramount Publix Corporation
United Artists Corporation
Universal Pictures Corporation
The Vitaphone Corporation
Western Service Studios, Inc.
Jam Handy Picture Service, Inc.
Wilding Pi[illegible]ure Products, Inc. 1497

Foreign Countries

Associated Screen News, Ltd.	Canada
British & Dominion Film Corp. Ltd.	England
Paris Studios Cinema	France
Les Studios Paramount	France
Nippon Katsudo Shashin Habushiki Kaisha	Japan
Far East Film Laboratory	Japan
Fono Espana S. A.	Spain
Fono Roma	Italy

1498 *Herbert M. Wilcox—For Plaintiffs—Rebuttal—Cross.*

Q. How many Western Electric motion picture reproducing systems are now in use in the United States and foreign countries?

Mr. Darby: The same objection.

The Court: Overruled and exception.

A. On December 31, 1933, there were 5,738 in the United States and 3,705 in foreign countries.

The Western Electric Company amplifiers
1499 were used in public address systems in 1920, in connection with the Harding Inaugural. Our company uses its amplifiers for public address systems now. Some of the phonograph companies acquired licenses in 1924 for electric recording and electric reproducing—the Victor Talking Machine Company and Columbia Phonograph Company in this country.

I witnessed an exhibition of De Forest pictures in the Fall of 1926, at their studio, I think it was on 48th Street. It was the Lee De Forest equipment there, I don't recollect whether it
1500 was the Fonofilm Company at that time or not. In my opinion, the results of that demonstration were very poor. At about the same time I heard and saw an exhibition of one of the De Forest new pictures on upper Broadway. My judgment in regard to the quality of that was about the same. I had experience in judging quality of sound pictures at the time I saw these exhibitions.

Cross Examination by Mr. Darby:

The first public exhibition of talking motion pictures with which I or my company was associated in 1926 was not that picture called

"The Jazz Singer," that was the picture called "Don Juan." John Barrymore was the star in that picture.

Until the producers began making talking motion pictures, there was no available supply of talking motion pictures to be exhibited in the various motion picture theatres. I understood that the pictures that were exhibited with the De Forest equipment that I saw were pictures made in the De Forest Laboratory. I presume 1502 that the De Forest people, in endeavoring to promote talking motion pictures, not only had to supply the reproducing equipment, but had to supply the films themselves.

Q. Now, you have referred to a number of licenses that had been granted by your company to producers. Have you got a copy of the license agreement showing the terms under which the licenses were granted to the producers with you here in court or can you get a copy? A. I presume I can get a copy.

Q. I ask you to please do so. 1503

Mr. Ashton: I do not know upon what grounds that would be pertinent, your Honor. I have no copy here of that agreement. It is a form agreement. If Mr. Darby would state what the pertinency of it is; I don't know whether I should object.

Mr. Darby: I will gladly state what the purpose is. Mr. Ashton has put in evidence through this witness, a beautiful picture of commercial success in the talking motion picture industry in connection

with the inventions here involved. The facts, as I can prove by this witness on cross examination are these: That licenses were granted to the producers; the producers were restricted by clauses in their contracts, not to permit the reproduction of the films that they produced, except on reproduction equipment acquired from the plaintiff. That explains the vast number.

1505 I likewise will prove that the restrictive covenants in the license agreements signed with the exhibitors or theatres precluded them from exhibiting on that machine any films that were not acquired from the licensed producers. In other words, it was the tie-up which formed the subject matter of the litigation in Delaware, and which I think, will paint an entirely different picture of the commercial success.

The Court: I understood you to say previously that you did not dispute commercial success and that it is not an issue

1506 in the case.

Mr. Darby: I do, your Honor, and that is the reason I thought that this entire line of testimony should be excluded, but being in, I think the true facts as to why it has expanded to the point it has, should be brought out.

The Court: There would not be any finding appropriate on the subject, would there, in a decree entered in this case?

Mr. Darby: There would not be a finding appropriate to it, no, your Honor. At the same time, in explaining commercial

success which is put in frankly for the purpose of bolstering up the patents,—if it is utilized for that purpose, it might reflect an erroneous conclusion.

The Court: Suppose you just call attention in your brief to the possibility of the erroneous conclusion on that subject.

Mr. Darby: Very well, your Honor, and for the purpose of any possible appeal record, may my last statement be accepted 1508 as an offer of proof?

The Court: Yes, that is the way I understand it.

Mr. Darby: So it will not be stricken when the record is completed.

The Court: Very well.

By Mr. Darby:

Western Electric and Electrical Products do not produce pictures, Mr. Darby. The first pictures that were made were recorded on discs by 1509 this system. Western and Products produced the equipment and supervised the recording. And the equipment was essentially of the character of a synchronizing disc record with the camera record. And the De Forest records employed sound on film. Sound on film is used practically exclusively in the industry today.

1510 *Donald McKenzie—For Plaintiffs—Rebuttal—Direct.*

DONALD MCKENZIE, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Donald McKenzie. I am staff engineer of Electrical Research Products, Inc. I
1511 have been employed by the Western Electric since 1920; by the Electric Research Products since December, 1929.

I heard a demonstration of the De Forest talking machine pictures in a New York theatre in 1923. It was either the Rivoli or the Rialto, I forget which one. The De Forest pictures were shown at one theatre, and subsequently at the other, for a few days. They were demonstrations rather than talking pictures as we know them now. There was a talking picture but only a reel at a time. In my opinion they were by
1512 no means of good quality.

Three years later, in September, 1926, I saw Dr. De Forest and his staff in his laboratory, which Mr. Wilcox referred to a moment ago. The demonstration there was in the sense that we heard some records which had been made, and we, actually at De Forest's request undertook,—that is the only occasion I did myself,—to be present and supervise the acoustic pick-up of the record he was making. The following day I heard the results on film without the picture. Those results were terribly smeared as to sound quality.

I had had experience in observing quality

prior to witnessing these exhibitions. Since 1922, we have been engaged in recording sound by electrical means in the laboratory, and I was myself in charge of the phonographic side of the sound film work. It was the Bell laboratories, then known as the engineering department of the Western Electric Company.

Cross Examination by Mr. Darby:

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This attendance by me at the Rivoli Theatre, was on my own initiative. I don't recall that this De Forest talking picture was advertised on the electric sign outside of the theatre. I saw it in the newspapers. I do not recall what motion picture star was playing there that night. It was not at night when I went there. This De Forest film was only one reel. I read in the newspaper that it was a special attraction; it was to play for a week. I paid admission to go to the theatre. I did not notice people paying admission, but there were many people there.

1515

You have shown me what purports to be a photograph of the Rivoli Theatre and asked me if I can identify that as the theatre that I attended on that occasion. I cannot identify it. I never saw it at night. It is customary for the theatres to have the same signs in the daytime as at night, but when I went to the theatre, I did not look at the sign.

By the Court:

The sign as shown on that picture does not refresh my recollection as to the name of the

theatre. I don't know whether it was the Rivoli or the Rialto.

By Mr. Darby:

I do not recall whether the picture I saw on that occasion had Pola Negri as the star. I do not go to pictures just for the fun of it, I went there to see what De Forest had.

1517 I am employed as staff engineer of Electrical Research Products; there are a few such. The company is continually striving to improve the equipment that it produces. Naturally, we are at all times striving to improve the quality of the sound equipment produced by our company. We have, it is true, improved the apparatus, so that better sound can be produced today over what we had in 1927, but we do not ourselves produce it, and we do not control the licensee in all details. Our present apparatus is capable of better sound. I hope it is capable of much

1518 better sound than in 1927.

DAVID SARNOFF, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Neave:

I am president of Radio Corporation of America. During 1928, I was general manager. In 1929, early, I was made executive vice-president.

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During the first half of 1929 I was in Paris with Mr. Young working on what subsequently became known as the Young Plan. That was embodied in an international agreement. I believe that we left to go abroad around the 1st of February, 1929, or the latter part of January and returned, I think, in the early part of June of that year.

I know Mr. Max A. Schlesinger, president of General Talking Pictures Corporation. I have 1520
had interviews with him. Those interviews were at his solicitation. Mr. Schlesinger has testified here that he had some interviews with me in 1928, before I went abroad with Mr. Young. I don't believe I can fix the date with exact precision, but I think it was probably around that period. My recollection of the first interview that Mr. Schlesinger and I had, and I think that his brother was present at the first interview,—as I say, my present recollection is that that interview related to some interests that Mr. Schlesinger expressed in equipment which he wanted 1521
for South Africa where his brother was operating. We had several subsequent interviews. At the subsequent interview he told me what it was that he wanted to talk about. The discussions at the subsequent interviews, as I recall, related to his suggestions of a possibility of consolidation of the patent situation in the field which he said his interests controlled, with those with which Radio Corporation controlled. We discussed those possibilities at several interviews, and also, I think, at one of the interviews, a suggestion was made that we might purchase the interests of his company and consolidate them with

the Radio Corporation. That suggestion was made by Mr. Schlesinger. Nothing came of those negotiations or interviews. I knew at that time that the Radio Corporation, together with others, including the American Telephone and Telegraph Company, had granted a license to the American Transformer Company, in certain fields, not including talking motion pictures. As far as I can recall, American Transformer Company or any
1523 of its apparatus was not mentioned in my interviews with Mr. Schlesinger. Mr. Schlesinger, purporting to state what was said at his interview or interviews with me, has testified in this case:

> "Mr. Sarnoff said to me the American Transformer Company—I told him I had bought from the American Transformer Company the amplifiers which his people had known through investigation."

1524 I do not remember any such statement by him. Mr. Schlesinger further testified yesterday that I said to him in some of these interviews:

> "Well, they are a licensed firm, and that is all right."

The "they" meaning the American Transformer Company. I did not ever say that to him. I am quite certain of that.

Cross Examination by Mr. Darby:

Q. At the time Mr. Schlesinger saw you and suggested a possible merger and whatnot, did

you cause his situation to be investigated by any assistants of yours? A. I referred the matter to Mr. Schairer, the head of the patent department, who is one of my assistants, and asked for his views on it. 1525

As to whether an investigation was made, as far as I know, I cannot answer that question definitely; it may be that Mr. Schairer may be able to. Mr. Schairer made a report to me. I do not recall in what form, but I recollect that it was negative. I assume that Mr. Schairer reached his conclusions, but I do not know whether it was as a result of an investigation or a study of the patent situation. I believe that Mr. Schlesinger did tell me at the time I had the conversation with him, and I did have a general knowledge that he had sound reproducing equipment in the field, I knew that apparatus was being used to project talking motion picture film that was being produced by the various producers in the United States. I would assume that that apparatus employed amplifying apparatus and vacuum tube amplifiers. 1526 1527

I do not recall that during the conversation with Mr. Schlesinger, he told me, as one of the elements of his set-up, that he was employing amplifying apparatus that had been purchased from one of the RCA licensees. I do not recall during that conversation with Mr. Schlesinger, the subject of amplifiers came up for discussion at all. I do recall, however, that the subject of patents came up. That is, the patents owned by Mr. Schlesinger's company and the patents owned by my company.

I recall, I think at our last interview, that I

asked Mr. Schlesinger, in response to or after he had made the statement of his patent situation as to whether he really believed that he could continue to produce his apparatus in that field without a license under any of the patents of the Radio Corporation or General Electric or Westinghouse or the American Tel. & Tel. or Western Electric, under all of which my company was licensed, whether he thought he could
1529 continue without infringing those patents. And I recall his statement that he believed that he could do so without infringing the patents. I also recall asking him whether it was his position that our system on the other hand infringed his patents, while his system was free from infringing any of our patents, and I recall his statement to the effect that he so believed. I recall that, because it made a very profound impression on me. I don't recall his telling me that the amplifying apparatus that he was employing was licensed by the Radio Corporation,
1530 or acquired from a Radio Corporation licensee. I do not recall our discussion having been broken down to any sub-division of the problem. I recall in particular, the broad question and his general response. I do not remember our discussion as to any circuits, devices or anything of that sort.

As to whether Mr. Schlesinger told me on what he based his belief that he could continue without infringing any of the patents owned by Radio Corporation or its associated companies, I don't believe he did, and I do not believe I asked him, because I do not regard Mr. Schlesinger a patent expert, and I am not one myself.

By the Court:

I do not recall sending any of our engineers to Mr. Schlesinger's studio for the purpose of investigating his equipment.

I do not recall issuing orders to any of my associates or subordinates to do that.

I have no recollection of any report from any of my subordinates based or purporting to be based upon an investigation of his equipment in 1532
his studio, but I do recall a report from Mr. Schairer, and all that I retain of that report is the general conclusion. I do not recall that that report contained any observations made by engineers concerning the nature or character of the equipment employed in the Schlesinger studio. If I may add, I do not recall now whether the report which Mr. Schairer made to me was a written or an oral one, but it has been my general custom to talk these matters over with Mr. Schairer.

1533

Re-direct Examination by Mr. Neave:

The report of Mr. Schairer was on the General Talking Pictures patents.

The RCA Photophone is a wholly owned subsidiary of the Radio Corporation.

If the RCA Photophone was looking for or desired to have additional studio space, and if their representatives went around to examine premises to look for such studio space, that is not a matter that would normally come to my attention. It might come to my attention, but ordinarily it would go to the executive vice-president of the field in charge.

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Re-cross Examination by Mr. Darby:

From my recollection and knowledge of what is done by my assistants in connection with the matter, I am not in a position to deny that engineers of the Radio Corporation did inspect the equipment of the General Talking Motion Pictures Company.

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OTTO S. SCHAIRER, called as a witness on behalf of the plaintiffs in rebuttal, having been first duly sworn, testified as follows:

Direct Examination by Mr. Neave:

I am the vice-president of the Radio Corporation of America. I have held that position since the Spring of 1930. My duties in that position included and do include the formulation and recommendation of policies with reference to the

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granting of licenses by the Radio Corporation. There have been put in evidence here the 1920 and the 1926 cross license agreements between the American Telephone and Telegraph Company and the General Electric Company, and the extension agreements to the Western Electric Company and the Radio Corporation, and also the license from Radio Corporation, American Telephone and Telegraph Company, General Electric Company and Westinghouse Company to the American Transformer Company. I am generally familiar with those various license agreements, but I am not especially familiar with the American Transformer license. I knew

there was such a license. I know that was a restricted license, not for the use of talking motion pictures.

Q. In all these agreements that I have just referred to the licenses were restricted to specified fields of use. Will you tell us from the standpoint of the situation of the Radio Corporation of America why licenses granted by it were restricted to use in specified fields? I want to bring out facts from which it may be judged 1538 whether such restrictions were arbitrary or whether they were reasonable. I am not asking you for your conclusions; I am just asking you for the facts.

Mr. Darby: I object, if your Honor please. I think the reasons for it are wholly immaterial. The fact is they were so restricted, and I think that is the end of our inquiry. Whether it was arbitrary, just or unjust I think is not before the Court. 1539

Mr. Neave: We are dealing here with licenses restricted to certain fields. I wish to know from Mr. Schairer the business considerations back of such licenses and upon which the licenses were based. I do not ask him to state whether they were reasonable or unreasonable.

The Court: You do not ask him to construe the licenses in the sense that you expect him to say whether the purposes that he had in mind were actually reflected in the agreements or not; is that it?

Mr. Neave: No, that is perfectly true.

I have called his attention to these licenses merely as licenses of a class, restricted to certain fields. I do not expect him to discuss these particular licenses or any other particular licenses. Just as a business proposition, one of policy, what are the facts with reference to the granting of licenses restricting the use to certain fields.

1541 The Court: It seems to me, Mr. Darby, that it might be helpful in reaching a conclusion on this branch of the case. Perhaps it would not be. Perhaps all that would be accomplished would be consuming a little extra time and a little extra space in the record, and I do not think there would be any harm done to the defendant.

Mr. Darby: No, I am sure there will be no harm done; but the only point of my objection is that we are not concerned

1542 with why it was done. The fact is it was done. The Court must decide whether that is legal or illegal, irrespective of why it was done.

The Court: I might almost suspect that your objection was sound, but I am going to overrule it, with exception.

Q. Mr. Schairer, you know what I have in mind. Start with the purposes for which the Radio Corporation was formed. A. The Radio Corporation was formed originally—

Mr. Darby: May I go one step further, if your Honor please. We are going to

run into exactly the same situation that we did a moment ago.

The Court: We have not moved very far in the moment.

Mr. Darby: No, but we have started with why the Radio Corporation was formed. That is absolutely going to necessitate my bringing into this record to complete the story of the picture this entire anti-trust litigation in the Delaware court, 1544
the Government suit and the Government decree.

The Court: I do not think so. I think you might be satisfied with the explanation, and you might not care to contest it.

Mr. Darby: No, sir; because the reason is this—

The Court: If you do not, I do not see how your cause is affected.

Mr. Darby: The cause is not affected, but it is being utilized to paint a picture that cannot withstand illumination, your 1545
Honor. It is exactly the same story they tried to tell in the Government case and exactly the same story they tried to tell in the Wallerstein litigation.

Mr. Neave: Perhaps you misunderstand. He is not going to tell that story again.

The Court: All right, tell us.

The Witness: The Radio Corporation was formed originally to engage in the business of communication for tolls. That for a time was its primary business. When the corporation undertook to grant licenses it was not considered

advisable for it to grant licenses in the field of communications for tolls, because in that business we were competing with cables and wires, and our patents constituted the only substantial measure of protection we had for that new business. Our developments over all these years have been in the direction of improving the quality and reliability of that communication service, and to the degree and extent to which
1547 we have been able to improve that service thereby we have not been willing to grant licenses to others in that field. In other fields, such as for amateur, experimental and broadcast reception, we have granted licenses and they have been restricted to those fields in order, first, that the licenses might not engage in competition with our communication business, and also such restricted licenses have not authorized the licensees to sell that kind of apparatus for use in theatres, for instance, where the benefits obtained from the use of the inventions have been
1548 much greater than could possibly be represented by a reasonable or moderate percentage of the selling price of the apparatus such as we were satisfied with upon licenses granted for amateur, experimental and broadcast reception. In that latter field the only practical way to satisfy the demand of the public is to sell the operators outright, and in that case the only reasonable or practical measure of the value of the inventions is to accept a percentage of the selling price as a royalty.

These things, these vacuum tubes and the circuits on which we have patents, are useful in various of these fields and applicable to many

fields. And if we granted licenses not restricted to any particular field, the same things could be used in these other fields. So under those conditions we could not afford to grant any licenses at all in the field of communications for tolls unless they were so restricted, we considered we could not afford to do it. Nor could we grant licenses if the apparatus made under those licenses were free to be used in those fields.

And that applies to some of the other phases 1550
of our work that we have to do with. What I have stated is merely illustrative.

Cross Examination by Mr. Darby:

When I refer to "our patents" I am referring primarily and in the first instance to those of the Radio Corporation.

In addition to those, the patents under which we have the right to grant licenses which include the patents of the American Telephone and Telegraph Company in some fields, the Western Electric Company in some fields; Electrical Research Products in some fields; Westinghouse 1551
Electric & Manufacturing Company, and the General Electric Company in some fields in each case.

Between the years 1927 and 1930, we had the right to grant licenses under our own patents in the field of talking motion pictures. Under the patents of the Telephone Company, only for amateur, experimental and home use. Not for use in theatres under the Telephone Company's patents. Never have had that right. And if Mr. John E. Otterson testified to the contrary I disagree with him.

By the Court:

I do not recall having instructed any of my subordinates, or our engineering staff, to visit the studios of Mr. Schlesinger with a view to examining the reproducing apparatus there employed, and I don't believe it would have been within my jurisdiction.

I did not make a report to Mr. Sarnoff con-
1553 cerning Mr. Schlesinger's patents and scope and so on of the patents that he controlled, early in 1929. I didn't join the staff of the Radio Corporation until May, 1929. At that time Mr. Sarnoff was in Europe with Mr. Young. I first met Mr. Schlesinger and considered the patents that he offered to the Radio Corporation some time later, I don't recall just when that was; and I did make a report to Mr. Sarnoff upon my later consideration of those patents.

I was manager of the Patent Department of the Westinghouse Electric & Manufacturing
1554 Company until early in May, 1929, at which time I became director of Patent Development of the Radio Corporation of America.

Mr. Neave: Your Honor, while we are on this question of cross licenses in the testimony of Mr. Schairer, I would like to offer in evidence an agreement between the General Electric Company and American Telephone and Telegraph Company, of July 1, 1932, which is called the Substitute License Agreement and also is known as Agreement B-2. You will recall that there was the cross license be-

tween those two parties in 1920 and then there was a substitute license agreement between those two parties in 1926. That was known as Agreement B, or Modified Agreement B. This agreement of July, 1932, was a substitute for both of those prior agreements. The reason why I have offered it in evidence is because it shows the present situation of the parties as far as licenses are concerned; it shows that the licenses that were exclusive in the 1556
prior agreements have been changed; and more particularly it shows that the licenses are still granted for specified fields of use. That is, they are restricted licenses, restricted to licenses in certain fields.

The way this contract of July 1, 1932, came about was that in 1930 the United States brought a suit in Delaware under the Sherman Anti-Trust Act against the Telephone Company, Western Electric and Products, and against Radio, General Elec- 1557
tric and Westinghouse, and that suit was based upon complaints as to these 1920 and 1926 agreements that are already in evidence, and also other cross license agreements between the various parties. Those agreements during the progress of the suit, which never came to trial, were renegotiated and changed so as to strike out the exclusive exchange of licenses. The July 1, 1932, agreement B-2 between the General Electric Company and Telephone Company was one of those that were so changed. Then in November, 1932, consent

decrees were entered in that suit in Delaware. One of those decrees dismissed the Telephone and Western Electric Company from the case, and the decrees were entered upon a stipulation, entered into between the Government and the defendants, and in that stipulation the Government stated that it found no objections to these modified agreements, including this agreement B-2.

1559 I offer in evidence this agreement B-2 and I will ask if Mr. Darby will join me in a stipulation as to some of the facts recited.

Mr. Darby: I certainly object to the agreement. I do not see that it has any bearing whatever on the case—an agreement entered into in 1932.

Mr. Neave: The point is, your Honor, the Government has approved it.

Mr. Darby: Only approved it for one possible consideration, with which this

1560 case has no concern.

Mr. Neave: They approved it, with licenses restricted to certain fields. That is my point.

Mr. Darby: Only as anti-trust laws are concerned. That is not involved in this suit.

Mr. Neave: That is a matter of argument.

Mr. Darby: No. I object to it as irrelevant and immaterial.

Mr. Neave: One of our points in this case is that restricted licenses of the character you have to deal with here are re-

garded as unobjectionable so far as restrictions of licenses are concerned—restrictions to fields. This is one item of evidence in that direction. 1561

The Court: I think it may be admissible. I think questions of the weight to be attached to it are not at all simple. I think as an expression of the opinion of the Department of Justice in a Sherman Act case it may have some suggestive force. But it is perfectly obvious that if 1562
this Court disagreed with the views that the Department of Justice has recorded in that it would not hesitate very long to say so. You realize that?

Mr. Darby: Yes, sir; but that is not the point. The point is that Mr. Neave is presenting an agreement which the Department of Justice has accepted, insofar as presumably—here is the logical conclusion —that there is nothing in that agreement that the Department of Justice objects to, 1563
for the same reason that it objected to the previous agreements—namely, there were exclusive patent rights among the parties.

Mr. Neave is presenting it here in this case because of the fact that they included this restricted license feature which the Department of Justice was not in any sense concerned with in that litigation, and whether or not the Government approved it in 1932 in the anti-trust law case has no bearing whatever on what the situation was in 1929.

The Court: I am impressed a great deal by what you say.

Mr. Darby: May I have an exception, your Honor, for the purpose of the record, and may I have a copy of the agreement?

The Court: Yes.

Mr. Neave: I offer in evidence the agreement marked B-2, Substitute License Agreement, dated July 1, 1932, between General Electric Company and American Telephone and Telegraph Company.

(Marked Plaintiffs' Exhibit No. 40.)

1565 Mr. Neave: Mr. Darby, may we agree that in 1930 the United States brought a suit in the District of Delaware under the Sherman Anti-Trust Act, against the Telephone Company, Western Electric, Radio Corporation and subsidiaries, General Electric and Westinghouse, complaining principally that the cross license agreements then in existence between the parties, s[illegible] the 1920 and 1926 agreements, were unlawful?

Mr. Darby: I agree to that, yes, so far.

1566 Mr. Neave: That those agreements were after that suit was brought renegotiated and various other agreements were made between the parties, among which was the substitute license agreement that has just been marked Plaintiffs' Exhibit No. 40?

Mr. Darby: I accept your statement that they were renegotiated. I agree that this agreement of this date, Plaintiffs' Exhibit No. 40, was entered into at the time you state.

Mr. Neave: And will you also agree that in the stipulation upon which the consent decrees were entered in November of

1932 there is this provision: "The petitioner, by its Department of Justice, has examined all of the agreements attached hereto, also the abovementioned Substitute License Agreement (B 2) and agreements relating thereto, and finds no objection to them."

Mr. Darby: Might I read the entire stipulation?

Mr. Neave: Surely.

Mr. Darby: I will state to your Honor 1568
in connection with my objection that I was rather feeling in the statement I made to the Court because I was acting as Special Assistant to the Attorney-General in that case, and I am somewhat familiar with these stipulations. If your Honor please, I will admit that the stipulation was entered into, but I would like to have the entire stipulation in.

Mr. Neave: I offer in evidence the entire stipulation from which I read. I have no loose copy at the moment, but I will 1569
have one tomorrow morning.

Mr. Darby: Your Honor, for the sake of the record might I make the same objection, however, to its admission, as to its relevancy and pertinency, as made in connection with the other offer?

The Court: Same ruling.

(Marked Plaintiffs' Exhibit No. 41.)

Mr. Neave: Mr. Darby, you will also agree, will you, that in November, 1932, an order of dismissal was entered in that case in Delaware, dismissing the Telephone Company and the Western Electric

Company from the suit, that order of dismissal reciting that the agreements that were complained of "have been modified so as to eliminate therefrom the provisions thereof which said petition asserted to be unlawful and by reason of which relief was sought against said two defendants"?

Mr. Darby: Subject to my objection to the relevancy of the order of dismissal and subject to the request that the entire order go in, I have no other objection. Exception.

Mr. Neave: I will bring a copy of the entire order in the morning, with copies for Mr. Darby.

The Court: The date of the order is what?

Mr. Neave: November 21, 1932, and the stipulation was dated the same day.

(Marked Plaintiffs' Exhibit No. 42.)

Mr. Darby: Exception.

Mr. Neave: Mr. Darby, will you agree that it is common practice where a patented invention is applicable to different uses, to grant written licenses under United States patents restricted to one or more of the several fields of use, permitting exclusive or non-exclusive use of the invention by the licensee in one field and excluding its use in another field?

Mr. Darby: I do not agree. As a matter of fact I believe that just the opposite or the contrary is true.

Mr. Neave: We will prove it.

Franklin T. Woodward—For Plaintiffs—Rebuttal—Direct. 1573

FRANKLIN T. WOODWARD, called as a witness on behalf of the Plaintiffs in rebuttal, being duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Franklin T. Woodward. I am assistant general patent attorney of the Western Electric Company, and general patent attorney of Electrical Research Products. I have 1574
been employed either by the Western Electric Company as a patent attorney or one of its subsidiaries since 1908.

My department made an investigation in 1929 of talking picture amplifiers leased by the General Talking Pictures Company, the defendant in this case. The first investigation was on April 11th, 1929; the second and more detailed investigation was on April 19th, 1929. The investigation was made at the Strand Theatre in Allentown. A few days before April 11, 1929, I 1575
had been informed that there was a General Talking Pictures installation at that theatre. The investigation disclosed that there was an installation in that theatre. That was the first opportunity that we had been able to get to see a De Forest Fonofilm equipment.

The reports which came to me shortly after the 11th of April with regard to the investigation of the 11th showed generally circuits but did not show them completely in the sense that they did not show the values of the various pieces of apparatus, such as resistances, capacities and so forth, and it was for that purpose

that the second investigation was made on the 19th.

After we had received the complete report we had made a careful engineering study of the various circuits shown in the reports. That was after the 19th; because it was not until the 19th that they had the measured values of the various elements. Made an engineering study to determine how these various circuits
1577 operated, and also patent study to see how they applied to the patents under which we were operating and under which one or more of the plaintiffs in this suit owned or had the right to sue. That was in itself a substantial job.

Our studies were complete early in the Summer of 1929, and my recollection is that bills of complaint were drawn up, at least tentatively, and we referred to Mr. Otterson for executive approval as to the bringing of suits in the latter part of July.

I am informed that Mr. Otterson went abroad
1578 on August 2, 1929.

We received an authorization to bring suit from Mr. Ling, who was then vice-president of the Products Company. Speaking for Mr. Otterson, he told us that he had been in telegraphic communication with Mr. Otterson, authorizing us to bring suits. That was on or about August 30, 1929. Then the suits were brought on September 13th, 1929.

Mr. Ashton: Mr. Darby, I will ask you to stipulate certain suits which I will mention, which were filed by the Western Electric Company and other plaintiffs

here, on these amplifier patents of the Telephone Company. The first suit was Western Electric, *et al.* vs. Biophone, in the District of New Jersey.

Mr. Darby: Just a minute, Mr. Ashton, before you proceed with that. May we have the Court rule on the relevancy of it? I object to it. I do not think it is material.

Mr. Ashton: The point, your Honor, is that we were not only bringing one suit against these defendants but bringing other suits at the same time, and it shows that these patents were being vigorously prosecuted. That is the point of the thing. They are matters of record and probably could be referred to, but I feel that their proper place is on the record here.

Mr. Darby: I say it is irrelevant and immaterial, the fact of their bringing suits against anybody else.

The Court: It strikes me so, Mr. Ashton.

Mr. Ashton: It is very pertinent, your Honor. The first suit which was brought, as so frequently happens, was brought a substantial time ahead of the present suit, and was of course a test case. That frequently happens. Sometimes defendants who are openly infringing are not sued for years.

The Court: I understand, but take your first case. Was an action brought for the infringement of these patents?

Mr. Ashton: Yes.

The Court: Did that case go to an adjudication?

Mr. Ashton: The case that went to adjudication is the Wallerstein case. The Wallerstein case, the first bill of complaint in that case was filed on June 10, 1929.

Mr. Darby: That is already of record.

Mr. Ashton: There was one suit filed that I started to refer to a minute ago, some time earlier.

1583 The Court: You have not put a question now. You have asked Mr. Darby to stipulate.

Mr. Ashton: Yes.

The Court: As I understand it he says he is willing to stipulate if he is convinced that the evidence is relevant. Is that it?

Mr. Darby: That is it, your Honor.

The Court: Why not let Mr. Ashton finish his question directed to you, so that the question may contain the necessary dates and titles, before you answer him?

1584 Mr. Darby: All right, your Honor.

The Court: Have you a date on the Biophone case?

Mr. Ashton: No, we have not. Continuing from where my question or statement left off, the Biophone bills were filed June 11, 1929. Still an earlier suit was Western Electric, *et al.* vs. Stanley Company of America, filed in the District of Delaware on May 16, 1929. A consent decree was entered in this suit on December 11, 1933, as to the Lowenstein patent.

Mr. Darby: What happened to the remainder of them?

Mr. Ashton: The bill of complaint was dismissed without prejudice as to three of the patents, and as to the patents passed upon by the Court of Appeals here in the Wallerstein case it was dismissed with prejudice. The earliest suit of all was the suit of Western Electric, *et al.* vs. Pacent Reproducer Corporation, *et al.*, filed in the Southern District of New York on March 30, 1929. A second suit was filed against this same company due to a ruling 1586
that there was a misjoinder of parties plaintiff in the original suit. This second suit was filed on June 7, 1929. In that suit a decree was entered on October 22, 1932, providing for an injunction and an accounting on the Lowenstein patent.

Mr. Darby: Was that by consent?

Mr. Ashton: That was a consent decree.

Mr. Darby: And what happened to the remaining patents in the suit?

Mr. Ashton: They were dismissed with- 1587
out prejudice. The case of Western Electric vs. Wallerstein was filed on June 10, 1929, in the Western District of New York at Buffalo. That is the case in which the opinion of the Court of Appeals has been presented to your Honor.

The Court: That is not Judge Winslow's case?

Mr. Ashton: No, the Wallerstein case was decided by the Court of Appeals of the Second Circuit, originally tried by Judge Galston, who was assigned to go to Buffalo in January.

Mr. Darby: Judge Winslow's case was a radio case, your Honor.

Mr. Ashton: The original Wallerstein bill of complaint was filed on April 20, 1929, in Buffalo, and that was dismissed for misjoinder of parties plaintiff for the same situation as was involved in the Pacent case.

Mr. Darby: Does that complete it?

Mr. Ashton: Yes.

1589 Mr. Darby: Will you complete your statement before I make my objection to the entire thing, and tell us what happened to the first suit that you mentioned, the Biophone, or something like that?

Mr. Ashton: The Biophone.

Mr. Darby: Is that it?

Mr. Ashton: Yes.

Mr. Darby: You did not tell us what happened in that case.

Mr. Ashton: That case is still pending.

1590 Mr. Darby: It has never been tried?

Mr. Ashton: Never been tried.

Mr. Darby: I accept Mr. Ashton's statement as to the facts. I object to the admissibility of the statement, as irrelevant and immaterial.

The Court: In other words, you answer his question in the affirmative, but without prejudice to your right to urge that that situation does not have any bearing on this case?

Mr. Darby: That is right, your Honor.

The Court: That will avoid an objection.

Mr. Darby: Mr. Ashton, in connection with that statement is it not a fact that none of those cases involved a situation presented by the defendant employing apparatus acquired by a licensee of the R. C. A., as an issue before the Court? 1591

Mr. Ashton: I have already told you that the question of vacuum tube license was involved in the Wallerstein case and was not even mentioned in the decision, and the petition for rehearing specifically on that point denied. 1592

The Court: That may be informative, but it does not strike me that it is. He asked you a plain simple question, and I do not think you have answered it. He says, is the issue raised in any case of a defendant having purchased an amplifier from a licensee? Isn't that the question?

Mr. Darby: That is the question, your Honor.

The Court: I do not think your answer is responsive. 1593

Mr. Ashton: I am sorry, your Honor. I accept your understanding or recollection of the question, but I did not understand Mr. Darby to mean it as narrow as that. If he means by his question the question of purchase of a complete amplifier alone, there has been no case, that is true. But the question of tubes has been raised. Of course there has been no case involving these arguments or estoppel, either.

The Court: Yes, but we are confronted

here with the acquisition of a complete amplifier.

Mr. Ashton: That is true.

The Court: From a licensee. The amplifier not containing the tubes, the tubes having been purchased by the defendant in the open market.

Mr. Ashton: Very true, your Honor.

The Court: That precise question, as I
1595 understand it, has not been presented in any of the cases to which you have referred in your stipulation?

Mr. Ashton: No, not precisely. As a matter of law I think it unquestionably has been.

Q. Do you know whether it has been common practice for any substantial period of time, where a patented invention is applicable to different uses, to grant written licenses under United States Letters Patent, restricted to one or more
1596 of the several fields of use, permitting the exclusive or non-exclusive use of the invention by the licensee in one field and excluding its use in another field?

Mr. Darby: I object to the question as irrelevant and immaterial, and, what is perhaps more fundamental, the incompetency.

The Court: That is quite an important matter, isn't it?

Mr. Ashton: It is very important, your Honor. To give you a little background on it if you would care to hear it, the pre-

cise stipulation which Mr. Neave read to Mr. Darby is the one which was stipulated in this case which I told you about in the opening statement, the so-called Independent Case that was settled. And then Mr. Davis made the same stipulation in the Wallerstein case, and it was on a stipulation such as that that that case went to the Court of Appeals. 1597

Mr. Darby: No, the case never went to the Court of Appeals. 1598

The Court: I apprehend that Mr. Darby is going to point out that the practice necessarily has been influenced by the decisions of the United States Supreme Court and an abstraction such as you propounded to the witness calls upon him to make only an argumentative response.

Mr. Ashton: I do not think that is true, your Honor. I am asking him whether he knows that it has been such a practice. If Mr. Darby objects to his qualifications, as to why he would know if there was any such practice, I would be very glad to go into that. But I am merely asking him whether he knows that it has been common practice. 1599

The Court: Perhaps I was pretty rude in not giving Mr. Darby an opportunity to state what his objection was. I think I should have.

Mr. Darby: I think your Honor has correctly stated it. Moreover, I do not see how it is possible for Mr. Neave to produce a man who has been a certain number of years with the Western Electric Com-

pany in the Patent Department, to give testimony, of any competency whatever, on the question what is common practice. He can certainly state what is common practice with the Western Electric Company, if it is relevant. Mr. Ashton called me up and told me that Mr. W. H. Davis had entered into such a stipulation in the Independent Wireless Case, and asked me if I would do the same thing. I told him
1601 I could not conscientiously, because not only could I not agree that that was the common practice, but I know I thoroughly disagree with whether it was or not. In other words, I was confident that was not the common practice. In my own case, I know I would not allow my own clients to do it, because I did not think it was legal.

The Court: It is a kind of technical situation here, Mr. Ashton, and I would like to get into the record as matter for the reviewing court whatever testimony
1602 would be relevant on the question of the practice known to this witness. I am wondering if you could reframe your question so as to ask him what the practice to his knowledge, on the part of the Western Electric Company, has been within a certain period of time.

Mr. Ashton: I can do that. His experience, your Honor, is wider than merely what the Western Electric Company and these other companies have done as far as contracts which have originated with them. It extends also to contracts with other and independent inventors.

The Court: When was Bauer vs. O'Donnell decided?

Mr. Ashton: I cannot tell you, your Honor, without perhaps getting the book.

The Court: It was about fifteen years ago, wasn't it?

Mr. Darby: Yes, your Honor, perhaps a little bit longer than that. About 1923.

The Court: That is only eleven years ago. That certainly must have influenced 1604
the practice, must it not?

Mr. Ashton: Not as to these things at all, your Honor, because those have never—

Mr. Darby: It was 1912, your Honor.

Mr. Ashton (Continuing): —been taken up by the Patent Bar. You were suggesting, your Honor, that it be confined to some period of years that I had not in mind, to make it definite, but I have no objection to doing so.

The Court: I think you had better make 1605
it definite as to a period of years and either restrict it to the Western Electric Company or else lay a broader foundation.

By Mr. Ashton:

As to what experience I have had since my employment as a patent attorney by the Western Electric Company, with patent license contracts, I have had some experience along that line ever since I have been with the company, but more particularly since 1924. One of my regular duties is to consider the advisability of and negotiate licenses under the patents of others as well as

prepare and or approve contracts for licensing under our patents.

Q. What do you know about the practice of entering into restricted license agreements by the patentees and by companies owning patents? A. It is the common practice for—

Mr. Darby: I make the same objection, if your Honor please.

1607 The Court: It is not necessarily conclusive on you. You can produce your witness who will testify that he followed your practice—or I mean the practice that you believe prevails.

Mr. Darby: I am willing to stipulate, if it will be of any assistance to Mr. Ashton, that it is, if he tells me it is, the common practice of the Western Electric Company and the Radio Corporation to do that.

Mr. Ashton: It is broader than that—much broader than that.

1608 Mr. Darby: I do not believe you have established the competency of this witness to testify about it.

Mr. Ashton: As to that I will ask another question.

Mr. Darby: I am at your last question now, which is based on one qualifying question, which I submit does not qualify the witness to answer.

Mr. Ashton: I will ask a further question on qualifications.

By Mr. Ashton:

During this period in which I have had to do with contracts, I have received contracts from

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patentees having no connection with the Western Electric or associated companies, as well as from companies owning patents, to pass upon.

Mr. Darby: May I test the qualifications of the witness before he testifies on the subject?

The Court: Yes, I think you are entitled to that.

1610

Preliminary Cross Examination by Mr. Darby:

As to whether all these contracts have been in connection with negotiations with the Western Electric Company either to grant licenses under Western Electric or associated companies' patents or acquire licenses for the Western Electric and associated companies under patents owned by others, the first part I had assumed. My answer was directed to the second part—that is, those who had offered us, came to us asking us to acquire licenses, and the form of contracts they submitted to us. Yes, all having to do with your work with the Western Electric Company.

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Mr. Darby: I renew my objection.

Mr. Ashton: I think he has qualified now, your Honor, surely.

The Court: Yes, I will take it. Objection overruled, with exception.

By Mr. Ashton:

Q. Do you know of any contract upon which the defendant in this case has relied which is

1612 a restricted license contract? A. Do you mean under which we have taken a license?

Q. No, under which your company has claimed a license?

Mr. Darby: I certainly object to that. If there is any contract in this case on which we are relying, it speaks for itself.

Mr. Ashton: Mr. Darby, the contract
1613 which I am referring to is the contract that you relied upon in the Stanley case in Delaware, and in which you insisted on behalf of this very defendant upon very definite restrictions in the contract itself, namely, the Western Electric agreement, that Dr. De Forest entered into with the Western Electric Company.

Mr. Darby: Is that contract in evidence in this case?

Mr. Ashton: It is going to be offered.

Mr. Darby: You mean it is not in evi-
1614 dence at the present time?

Mr. Ashton: It is going to be offered in a moment.

The Witness: The contract handed me, between the De Forest Company of Delaware and American Telephone and Telegraph Company, I believe—I am looking for the parties here—and the Western Electric Company, Inc., was negotiated while I was in Europe, but I have frequently had occasion to consider it since my return. I considered it in connection with the litigation which was just referred to, brought by this defendant against the plaintiff.

1615

Q. And did the defendant in this case rely upon the restrictions in the contract?

Mr. Darby: I object to that, if your Honor please.

Mr. Ashton: It seems to me, your Honor, that that is directly in point. Mr. Darby is going very far in his statement as to the policy of his clients and so on, in entering into these agreements, and it seems to me it is very pertinent that he has stressed these restrictive provisions in this contract in a talking motion picture litigation in Delaware, brought against the same plaintiff.

1616

The Court: That brings us back to where we were last Thursday morning, I think. I asked you how long it had been the rule that lawyers had to be consistent, and the rule has not changed since then.

Mr. Ashton: I did not mean to suggest that he should be consistent, but I think it has a bearing on our proofs.

1617

The Court: You see how leading the form of your question is. The contract relied on by the defendant in this case, as I understand it, is the license between the plaintiffs in this case and the American Transformer Company. It has nothing to do with something that was brought into another litigation.

Mr. Ashton: I understand, your Honor. This bears on the common practice to enter into these agreements and that is all I am trying to—

1618

The Court: Why not ask this witness whether he knows that this defendant company, the General Talking Pictures Corporation, ever entered into a restricted license agreement with anybody else?

The Witness: I do not know that.

Q. Do you know whether the General Talking Pictures Company has relied upon such an agree-

1619 ment?

Mr. Darby: I object to that, if your Honor please.

The Court: I will sustain the objection, with exception.

Q. Will you refer to other licenses restricted to particular fields of use or purposes which have come to your attention (handing witness papers)?

1620

Mr. Darby: I object to this, if your Honor please.

The Court: Do you want him to state a number, or do you want him to state facts with reference to each?

Mr. Ashton: I want him to point out a few of the agreements, your Honor, to show that it was common practice to have such agreements. That is exactly what I want, and I want him to point out the fields of use which these agreements have been limited to and mention a few of them as briefly as possible.

The Court: Is he going to present con-

tracts that were offered to him by persons desiring to enter into contractual relations with the Western Electric Company?

Mr. Ashton: I think it is largely that. There are several other agreements that have come to his attention in connection with his usual work, which I also had in mind to ask him to refer to, including this one that we just had a moment ago. 1622

The Court: Cover it as briefly as you can in justice to your case, Mr. Ashton.

Mr. Ashton: I am perfectly willing to offer the contracts in evidence themselves and let them speak for themselves. I do not think it is necessary to have the witness refer to each one in detail. I will therefore do that when I offer my exhibits.

The Court: Would your purpose be served by waiting to see what Mr. Darby develops in cross examination on this subject? The witness has made a statement 1623 as to what he knows the practice to be, and he states that in a large number of instances such contracts have been presented to him and have been entered into by the Western Electric Company with persons presenting them. Isn't that *prima facie* all the proof you need?

Mr. Ashton: I will turn the witness over at this time, your Honor.

Cross Examination by Mr. Darby:

It is correct that the Telephone Company is interested—and by the Telephone Company I

mean the Telephone Company and Western Electric Company, just those two for the moment—are interested only in certain lines of work, namely, the transmission of intelligence, transmission and reception of intelligence—communications, in other words, is correct.

It is the standard policy of the Telephone Company when inventions are submitted to them to be sure that they get rights in that particular
1625 field. I would assume it is frequently to my knowledge and in my experience immaterial to the Telephone Company if it gets rights in additional fields, as long as those particular fields in which we are interested are protected.

In purchasing patent rights from different people it is a general practice with the Western Electric Company and the Telephone Company to purchase only rights in the particular fields in which it is interested, although I have known of instances where they would have acquired further rights if they could have.

1626 In some instances rights in their particular field were all that were offered them. May I qualify that? Not only that, but sometimes even less than their particular field—even less than the whole of their particular field. I have in mind the negotiations with the General Electric when I make that statement.

As to whether it is not a fact that in the acquisition of rights under the De Forest patents, the audion, the 3-electrode audion patent, the original audion patent, that we were able to acquire rights for our particular field for less than was asked for the use of the audion in other fields, I was not in on those negotiations, but I

recall that they covered three or four separate negotiations eventuating in separate documents, and I asume that is a fact. I am familiar with those agreements.

Broadly stated it is true that the patent policy of our company, to protect ourself against attack rather than to acquire patent rights with which to attack others. We do not want to pay for anything which we do not need, and we do not want to buy litigation. And for that reason, 1628 so far as the commercial operations of our company are concerned, all that we are primarily interested in is to acquire rights under any patents which we think might interfere with our continued operation.

Mr. Darby: That is all I have to ask the witness on that subject, your Honor, unless there is any phase of it that occurs to your Honor. I have further cross examination of the witness, however.

The Court: Then go on with it. 1629

In connection with these circuits that were sent to me in April, 1929, showing what the General Talking Pictures equipment consisted of, sketches and written reports were sent to me. The report stated who was the manufacturer of the apparatus. I remember that very distinctly. One amplifier had the manufacturer's label on it, yes. The vacuum tubes were not sent to me with the report. I don't recall for sure whether any measurements were given for the internal impedance of the vacuum tubes in the report, but I know that they made on the second test, the

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second inspection—they made such measurements as the engineers deemed necessary to know exactly how it worked. I am very sure the report gave the characteristic type numbers of the vacuum tubes. I don't recall whether the report included any measurements of internal resistance or impedance in the tube.

Re-direct Examination by Mr. Ashton:

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The first that I knew that the General Talking Pictures Corporation had made an installation of an American Transformer Company amplifier was in the early report of the inspection of April 11th, 1929.

FRANK N. WATERMAN, resumed the stand.

Direct Examination Continued by Mr. Ashton:

1632

Q. Will you continue with the references against the Straight Line Characteristic Patent? You had not completed the Colpitts patent 1,137,384. I believe you had one more thing that you wished to state as to that. A. So far as I recall I was stating at the end of the answer last given the necessity for adjustment of the generated frequencies and the modulation intensity with respect to one another. Correcting that statement, the adjustment of frequency and intensity of oscillation, and the adjustment of the intensity of modulation, in order that the carrier wave might properly represent the signal. That is the

reason for the large number of adjustable elements, and it is one of my reasons for believing that the element referred to by Mr. Cloud is an inductance and not a resistance.

Q. Kendall patent No. 1,330,471, Tab No. 20.

A. As I recall the matter, Mr. Cloud referred to the resistance 80 in the middle stage of Fig. 4 as being a plate circuit resistance. I call your Honor's attention to the fact that the resistance 80 is a parallel feed. It carries the current from 1634
the battery to the plate 33, while the alternating current path is through the condenser 81, the primary coil 82, thence back to the filament. Thus the alternating current path is different from the direct current path, and the sole effect of the resistance 80 in a parallel path is to decrease and not to increase the total output resistance, since two paths are easier than one. It make no difference what the resistance of 80 is, it decreases the total plate circuit resistance. Therefore, it is not a resistance added to an existing circuit. The filament current is from 1635
a little battery, not numbered, just above the battery 35, and the filament circuit is a circuit purely local to that battery. The filament is a part of the plate circuit and the conductor on one pole of that small filament battery runs down to the negative pole of the battery 35.

By the Court:

Q. That is assumed to be the negative pole, isn't it? A. It is known to be, because the tube only works with the negative pole of the B battery connected with the filament. Therefore

the direct current flow is from the right hand pole of the battery 35 up through the resistance 80, then to the left, to the plate 32, thence across the space to the filament 30, and back to the battery.

Q. To the battery 31? A. The battery 35. It travels, part of it, actually through the battery 31. We ordinarily disregard that.

Q. It is not 31; it is an unnumbered battery.

1637 A. Unnumbered battery, adjacent to 31.

Mr. Ashton: 31 is the grid.

The Court: 31 is the grid, yes.

The Witness: The alternating circuit is from the plate 32 of the tube to the right through the condenser 81, then down through the primary 82, then to the left, back to the filament, the alternating current therefore circulating through the tube and the circuit that I have traced. It follows that insofar as alternating current gets

1638 into the resistance 80 it would start from the plate down through the resistance 80, then through the battery 35, back to the filament; but that resistance merely furnishes an additional path. Therefore it reduces the total resistance that the total alternating current has to encounter, and it makes no difference what the resistance of 80 is, it reduces the resistance of the alternating current path. If 80 is very large, then but little current will flow that way, and it will reduce the resistance only a little; whereas if it is smaller, then it will reduce the resistance still more.

By Mr. Ashton:

Q. Would not a modulating tube fail to modulate if it had a straight line output characteristic? A. Yes, it would, because the modulation is dependent upon the lack of symmetry in the reproduction, or as it is ordinarily stated, upon the distorting properties of the tube.

Q. That is, a curved characteristic rather than a straight one is required for a modulator, is it 1640
not? A. That is correct; just the same as for a detector.

Q. And it is necessary to deform the outgoing current in order to impose the voice upon it? A. Yes.

Q. If the unidentified resistance in this patent— A. Which one are you talking about?

Q. The same, the Kendall patent. I would like to know if the resistance in the Kendall patent 80 were relatively small, whether it could have any effect in the output circuit? A. Well, I assume that by "relatively" you mean relatively 1641
to the circuit, through the condenser 81 and 82.

Q. Yes. A. It would rob the output circuit to that extent and would limit the output of the tube.

Q. Only in the event that it was relatively small could it have any effect in the output circuit; is that right? A. That is true. Such resistance would be made of such value that it could be disregarded in the operation of the tube.

Q. And it is a parallel feed resistance, is it not? A. It is a parallel feed resistance entirely.

Q. And is a parallel feed resistance always made large? A. Yes.

Q. Why? A. In order that any effect which it has in carrying alternating current may be very small as compared to the current carried in the intended alternating path.

Q. Is the resistance 80 in the A-C output circuit? A. It is not.

Q. And the tube 33 is functioning as a de-
1643 tector? A. Yes.

Q. Will you refer to De Forest patent 1,375,-447, which is tab No. 24. In Fig. 1 of this patent the element 13 is a reactance, is it not, serving as a coupler whose value is not in any way indicated? A. That is true.

Q. Is the same also true of Fig. 2? A. Fig. 2 is a two-coil transformer, whereas 13 in Fig. 1 is a single coil or auto-transformer.

Q. What have you to say about the loud speakers in Fig. 5? A. The loud speakers are each operated by its own amplifier, and these
1644 amplifiers are connected to the secondaries of transformers whose primaries are connected in series in the output circuit of the tube 26. No description of any of the elements is given so that one knows nothing about what the transformers are, but the tubes or their grid circuit impedances may be. It is therefore wholly a matter of speculation as to what the nature of the output circuit of the tube 26 may be.

Q. Were the loud speakers available at the time of the application of this patent, namely 1913, any more than merely telephones supplied with horns? A. So far as I knew them, that is all they were.

1645

Q. Did ordinary commercial telephones have a low resistance and impedance? A. Yes.

Q. Can you compare the impedance of three such telephones with the impedance, for example, of one De Forest tube? A. It would be a very very small fraction. The De Forest tubes were very variable. Of course we did not in those days know anything about alternating current impedance of the tube. Since that subject has been understood, some of them have been re-

1646

pumped and tested, because it was practically impossible, as to most of those tubes, which had so much gas in them, to determine any definite alternating current resistance that would stay put, even if we had known how.

But from such results as I have had from use, and seen published, the plate circuit impedances of those tubes ran—I have not the exact figures in mind, but say from 50,000 to 250,000 ohms, whereas the telephones would have been at most of the order of 2,000 or 3,000 ohms, and probably much lower.

1647

Q. Does the patent make any disclosure as to the impedance of either the loud speakers or of the tubes? A. It does not.

Mr. Ashton: I have called Mr. Darby's attention to the fact that in a number of instances the prior patents relied on were applied for before the application dates of the patents in suit, but were issued later, and Mr. Darby has not proved what the applications contained as they were originally filed. I want to make it very clear to him so that he can have an opportunity

to do that, or some arrangement can be made whereby he will advise me of any differences.

Mr. Darby: I am perfectly willing to do it in the most expeditious manner. My understanding of the law in this Circuit is that when a patent is issued it is presumed to have issued on the application as filed, as appears on its face, unless
1649 something to the contrary is established.

Mr. Ashton: Will you undertake to furnish me the applications as filed, of any patents that you relied upon?

Mr. Darby: No, sir, I will not.

JOHN E. OTTERSON, recalled.

Mr. Darby: Mr. Zelony, will you step down here, please?

(The witness Zelony steps forward.)

1650 By Mr. Darby:

I do not recognize this young man. I do not recall that I have ever seen him before, except in this courtroom. I am quite positive of that.

FRANK N. WATERMAN, resumed the stand.

Direct Examination Continued by Mr. Ashton:

Q. We were on the Arnold patent 1,349,252, the Straight Line Characteristic Patent, and the next patent to be taken up is Weagant No. 1,384,108. This patent goes, does it not, to a

transmitter generating oscillations by what is known as gas interruption? A. It does.

Q. In other words, it is dependent upon the gas content of the tube for its operation, but was not intended for telephone signals? A. That is correct. It depends upon the gas operation and a critical adjustment of the voltages to the tube.

Q. Is the tube shown at 13 for adjustment purposes merely? A. The phone, you mean. Yes, 1652
the telephone shown at 13 is in order that the adjuster may determine when the tube is operating properly for transmission purposes.

Q. Does this appear from page 1, line 81, of the specification? A. It does.

Q. Is the signal sent by the key 11? A. It is.

Q. Is the resistance 15 shunted by a condenser 16 which carries the variable current? A. Yes, the variable current passes through the condenser 16. The resistance 15 serves only to carry the direct current and to determine with precision the voltage applied to the plate 9. 1653

Q. Does the resistance 15 have any substantial effect of increasing the A-C impedance of the output circuit? A. It does not.

Q. Is it stated at page 1, line 90, that the resistance 15 is not necessary to the operation of the device? A. It is so stated.

Q. Now, will you take up the Hewitt patent 1,393,369? Does Fig. 1 disclose a mercury arc? A. It discloses a mercury arc of a peculiar type, similar to that considered in the Pierce patent, with the exception that the control member 8 is coated with glass or other insulating material.

so as to be entirely insulated from the ion stream.

Q. And does Fig. 2 show a corresponding arrangement? A. It does, except that the tube is of the hot filament type instead of the arc type. The grid is similarly protected from conductive connection to the ion stream by enclosing it in glass or other insulating material.

Q. What is the purpose of the resistance 10?

1655 A. The resistance 10 is a ballast resistance for stabilizing the arc in the lower portion of its operating range before it passes into the negative resistance state.

Q. Were the uses of resistances and inductances common in mercury arc devices for the purposes of stabilization? A. They were. You can see that illustrated also at 5, 6, in the same figure, the arc being stabilized by inductance 6 and resistance 5. The arc of the anode 2 is stabilized by the resistance 10, and its own translating device.

1656 Q. And do the resistances 19 and 20 in Fig. 2 have the same purpose? A. They do.

Q. What does the patentee mean when he states at page 2, that the filament acts as a negative to receive positive current? A. It means that it acts as a cathode in the same sense that the mercury pool does in Fig. 1.

Q. What does that have to do with ionization or gas conduction? A. He merely applies the same terminology and the same reasoning throughout to the two devices, contemplating the same action, namely, ionized gas action.

Q. Does the inductance 9 and also the resistance 20 act to stabilize the current, and are they

necessary for that purpose? A. Yes, otherwise the blue haze would become self-perpetuating, and the devices would become inoperative. They are necessary to keep them in the critical state that they are desired, to operate as desired.

Q. Does the fact that the grid 16 is enclosed in glass indicate anything as to the type of tube? A. Yes, it indicates that the positive ionization is the phenomenon which he is using, and he desires to use the electrostatic field only which can 1658 pass through the glass with perfect readiness and does not desire to have the grid enter into any conductive relation that would disturb the arc.

Q. Now, we take up Arnold Patent No. 1,403,475, tab D, resistance capacity coupling patent and refer first to Arnold Patent 1,129,942, tab 10; do you agree with Mr. Cloud that the difference between resistance and inductance is an essential difference in this case? A. I do most emphatically.

Q. Have you any further comment to make on 1659 this Arnold Patent 1,129,942? A. Not unless you want the reason explained. The reason is that the inductance is not independent of frequency. The purpose of resistance capacity coupling is to get an arrangement which is independent of frequency components of the alternating signal current.

Q. We now take up the Nichols Patent 1,257,381, tab 18, and I just want to point out in connection with this patent that it is antedated according to plaintiffs' position, and that it does have a resistance battery coupling. Will you now comment on that, please, Mr. Waterman? A. It

has resistance battery coupling 15, as shown in the various figures, the purpose being to modulate the oscillator tube 17, in which case the tube 17 is an oscillator. The general scheme is to receive the very low frequency impulse on the cable, pass it on through a coupling tube to a high frequency oscillator 17, then detect, that is, get rid of the way it is put in and pass it on the outgoing cable. The object of the whole com-
1661 plicated arrangement is to avoid the necessity of transformers, at the same time to make possible the duplex operation of the cable.

Q. Will you refer now to Arnold Patent 1,398,665, tab 29; does it show any coupling between tubes? A. No, it does not. This merely relates to the high potential tube.

Q. Does it show a parallel feed with a reactance coil 8 for the output circuit of the tube? A. Yes.

Q. Now, will you please take up Arnold Patent in suit, 1,448,550, the Input Impedance Pat-
1662 ent, and I point out to your Honor that it is the plaintiffs' position that all the patents relied upon as to this patent have been antedated. Do you have any further comment to make on the patent itself, Mr. Waterman? A. I don't remember that I have.

Q. I thought you told me you had. We will pass then to the next patent, Arnold Patent No. 1,465,332, tab G, The Common Supply Plant. Will you refer to Arnold Patent 1,129,942, tab 10. In this Arnold Patent 1,129,942, is it material whether or not power is supplied from a common battery or from separate batteries? A. No, not the least.

Frank N. Waterman—For Plaintiffs—Recalled—Rebuttal—Direct. 1663

Q. Will you refer to the claims of the Arnold patent in suit, 1,465,332 in connection with the Arnold Patent 1,129,942, particularly claims 1 and 5 and point out whether or not you find the subject matter of those claims disclosed in Arnold Patent 1,129,942?

Mr. Darby: Oh, I object to that question, if your Honor please, I think that is assuming the authority of the Court.

The Court: That is the customary objection and it is customarily overruled. You may have an exception. 1664

Q. Do those claims call for series inductances as well as bridging capacity? A. They do.

Q. Is there any such inductance shown in Arnold Patent 1,129,942 as a filter means to prevent the oscillation in the system? A. There is not.

Q. Have you any further comment to make on those two claims? A. No.

Q. Now, will you refer to claim 8 for the moment, Fig. 6 of this Arnold Patent 1,129,942 just referred to, and also in Mr. Cloud's testimony, Defendant's Exhibit I; there are three tubes there, are there not? A. Yes. 1665

Q. Does the claim 8 read upon that feature, there being three tubes? A. No, it does not.

Mr. Darby: I make the same objection, your Honor.

The Court: The same ruling and exception.

Q. This Arnold patent shows three tubes, does it not, with only two of the plate circuits bridged? A. That is correct.

Q. Claim 8 calls for bridging of all three, does it? A. It calls for bridging each of the circuits.

Mr. Ashton: I point out to your Honor that the patent referred to above was 1,129,942.

Q. Refer now to Campbell Patent 1,227,118 and state whether or not the disclosure of this
1667 Campbell patent has any bearing upon the invention of the patent 1,465,332, in your opinion? A. I am unable to see that it has the slightest bearing. Of course, it sets forth a very notable invention, a landmark in the art, but that has relation to the matter of the passing of signals of certain ranges of frequencies in the line and cable transmission. I am unable to see that it has any bearing upon the particular combinations which are dealt with in the Arnold Patent 1,465,332. There is nothing to compare, because there is no resemblance.

1668 Q. Now, Alexanderson Patent 1,340,101, tab 21; are the tubes shown in this Alexanderson patent three-element tubes? A. No, they are four-element tubes, known as grid rectifiers. The purpose is to absorb part of the energy of generator 1. That is a part which is proportional to the signal transmitted through the microphone 18. It is what might be called a "robber circuit"; it robs the generator 1 and allows what it does not take to go out on the air.

Q. Are they amplifier tubes in any ordinary sense? A. No, they are not. I do not know that they are in any sense whatever.

Q. How would you refer to them, as variable

impedance tubes? A. They are variable impedances, energy absorbers in the nature of rectifiers.

Q. Is the plate supplied by battery 16 and not by generator 1, as Mr. Cloud testified? A. Well, it would be correct to put it both ways.

Q. It would? A. Whatever direct current bias is placed on the plates comes from the battery. The main purpose of the battery, however, is to provide progressively different negative biases 1670
on the several tubes, so that they come into action progressively according to the intensity of the signal. The idea is that a small signal such as microphone 18 might give would be able to modulate the output of the large generator of thousands of units of power; they are therefore governed in that peculiar way. They do act as energy absorbers.

Q. Is the aim to modulate the current from generator 1, which is the plate to antenna 2 and 3? A. Yes.

Q. Is the voltage from the microphone 18 im- 1671
parted to the transformer 15 to the grids of the tubes in parallel? A. Yes. They come into the plate successively, and they are always in parallel.

Q. Does the cascade operation exist in the disclosure of this patent? A. Oh, no, not at all; not at all. They are purely energy absorbers.

Q. Do currents successively amplified flow through the battery? A. No.

Q. Now, take up Arnold Patent 1,520,994, the Gain Control Patent, tab H. It is defendant's position that the invention of this patent constitutes double-patenting of the Arnold Patent

1672 1,448,550; will you compare the inventions, please? A. The patent 1,448,550 goes to the question of what the lines, the incoming signal circuit see as they come into the tubes. The arrangement being organized wholly from that point of view. The resistance 6 shown across the secondary of the input transformer in the drawing is shown as a fixed definite resistance, and so described.

1673 It is selected for the several purposes as I have explained in my earlier answers in my *prima facie* deposition. The tube receives the entire voltage drop across resistance 6.

In Patent 1,520,994 the purpose is to control amplification without affecting either the selected circuit conditions or the tube operation. Many methods of volume amplification control have been attempted. The trouble with most of them is that they affect the quality. The arrangement shown in Arnold Patent 1,520,994 gives complete control of the amplification without in any way

1674 affecting the performance either of the tubes or of the circuits. Physically and diagrammatically it differs only in that it has the sliding contact 26 which can take off any part of the alternating current voltage developed in the resistance 25 and applied to the grid. Actually the circuits may be designed from the point of view of volume control so that actually the resistance 25 is not necessarily the same resistance that would be used for the purpose of 1,448,550, although diagrammatically they are the same, and they might be the same actually. The patent 1,448,550 in no way suggests the possibility of the amplifica-

1675

tion control feature, which is the disclosure as I understand it, of patent 1,520,994.

Q. You were present and heard Mr. Kendall's testimony, did you not, regarding an attempt to make adjustments by adjusting the B battery? A. Yes.

Q. I would like to ask you if the result of doing that would be this—namely, varying the output impedance of the tube and changing the amplifying efficiency of the set-up? A. Yes. All of the methods which vary the other batteries have serious effects on the operating characteristics of the tube and the relation of the tube to the circuit. The method disclosed in 1,520,994 as far as I know is the only one developed up to date which does not affect the performance either of the circuits or of the tubes.

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Q. That is, you can make an adjustment without changing the constants which you have prepared in advance for the circuit? A. That is correct.

1677

Q. I would like you to refer back a moment to that Alexanderson patent No. 1,340,101, in connection with the preceding patent 1,465,332, tab 21, and I ask you if the purposes of the resistances 11 are not by-passes for alternating current by condensers 20, so that the resistances do not affect the alternating current characteristic of the rectifiers? A. That is correct.

Q. I mean beyond limiting the rectifying current the tubes can handle? A. The resistances 11 cooperate with the variable resistance of the tubes to act as energy absorbers. The alternating current is by-passed in the condenser 20. In other words, there is a rectified current there,

and where there is a non-rectified current the resistance will absorb energy from the rectified current. The alternating current is by-passed by the condenser.

Q. That prevents the tubes from destroying themselves, does it? A. Yes. That is explained in the specification.

Q. Now the patents relied upon with respect to the patent 1,520,994. Refer to the Von Lieben
1679 patent 1,038,910, tab No. 6, mentioned by Mr. Cloud, and state if this patent contains any disclosure pertinent to the Arnold patent in suit just referred to? A. The Von Lieben patent shows no amplification control at all. I believe that Mr. Cloud referred to the potentiometer *c* in Fig. 2. That of course is a potentiometer. It is placed across the filament, and the slider takes bias for the filament to the sieve member H, but it has no relation to the varying of the signal voltage applied to the grid, which is the essence of the Arnold arrangement in 1,520,994. I may
1680 say that the potentiometer *per se* is a very very old device. It is one of the oldest of electrical tools, and is used for many different purposes, so that I do not understand that there is anything novel in the potentiometer. It is the use that Arnold made of the potentiometer, which avoided the difficulties of distortion previously existing in attempts to vary amplification. That is the particular feature of the patent as I understand it.

By the Court:

Q. That is, he used an old device to accomplish a new purpose; is that it? A. That is my understanding.

By Mr. Ashton:

Q. In a special situation? A. Yes.

Q. Now the Pierce Patent 1,127,371, tab No. 9, also shows a potentiometer used in a highly gaseous audion circuit. What was its purpose in this patent? A. A potentiometer 60 is shown having the adjustable tap 63 in Fig. 2. The purpose is to take off a desired bias to the grid of the tube 13, so that after the tube has gone dead, 1682
or "plugged" as the expression used to be, the restoring relay 51 will restore it, that is the grid, to a definite potential selected in accordance with the particular sensitiveness of adjustments that initial control of the filament called for. Dr. Pierce, as I explained, and as he points out at the bottom of column 1 of page 1, is trying to reconcile a state of high sensitivity in the gas discharge with operability if strong signals come in.

Q. Now the Colpitts patent 1,187,384, tab No. 13. Will you point out the features of this circuit which Mr. Cloud referred to—I believe the resistance 26 in Fig. 2? 1683

Mr. Ashton: I will point out, your Honor, that the plaintiffs' position is that this patent has been antedated, and even if it were not, it has no bearing on the invention of the patent under consideration.

A. As I explained yesterday, the patent goes to the operation of a tube in the combined capacities of oscillator and modulator. That requires that the amplitude of the oscillations and of the modulating voltages due to the micro-

phone must be very carefully coordinated with one another. The purpose of the resistance 26 shunted across the secondary of the transformer 14 is to more or less short-circuit the transformer, thus absorbing in the transformer itself more or less of the energy of the signal from the microphone, in order to govern the modulation with respect to the intensity of the oscillation. The latter is governed by the various adjustments
1685 that I referred to yesterday describing this patent in another connection.

By the Court:

Q. Is 26 the potentiometer? A. No, it is a variable resistance. The same is true of 26 in Fig. 4. It is not a potentiometer in either case; merely a series rheostat.

By Mr. Ashton:

1686 Q. In the case of Fig. 4, in order to make it into a potentiometer you would have to connect the two resistances together and take off one of the taps there, would you not? A. That is correct.

Mr. Ashton: I will point out, your Honor, that the Kendall Patent 1,330,471, discussed by Mr. Cloud, has been antedated and no testimony will be taken on that. The same is true of the Van der Bijl patent 1,350,752.

Q. As I recall Mr. Cloud's testimony, he stated that he was familiar with the use of potentio-

265

meters from perhaps 1912 or earlier, but he did not know of their use in conection with vacuum tubes across the input circuit until some time later, perhaps 1915, I think it was. You yourself stated, I believe, that you had audions at an early date. What was the date that you first had them? A. I don't recall exactly. I think it was the winter of 1911 or 1912 that I began to work with the audion. No. I guess it was 1912 or 1913. It was one of those winters. 1688

Q. Did you place such a potentiometer across the input? A. No. No, I did not. I did not entertain that idea.

Q. Look at the Johnson Patent 1,432,863, and state whether that shows a potentiometer. That is Tab No. 31. As to that patent will you state whether it discloses a potentiometer in the input circuit? A. It does not. The resistance 12 in Fig. 1, and 26 and 28 in Fig. 2, are merely variable rheostats connected across the primaries of the input transformers for the tubes 9, 15 and 18.

1689

Mr. Ashton: I will point out, nevertheless, your Honor, that this patent is antedated, filed in 1918.

Q. Is this a correct statement with respect to the invention of the Arnold patent in suit which we are referring to—that it permits adjustment of amplification without changing the impedance facing the potentiometer on its input side, and that the device is located on the input side of the tube? A. Yes.

Q. With respect to all prior art patents as to which it is not plaintiffs' position that they have

been antedated, do you find any that shows a potentiometer across the input circuit? A. I do not.

Q. Do you find any arrangement which provides for adjustable amplification similar to the adjustment in the Arnold patent in suit? A. No.

Q. Do you find any arrangement which varies the amplification without affecting the impedance
1691 facing the input side of the potentiometer? A. I do not.

Cross Examination by Mr. Darby:

Q. You would agree with me, Mr. Waterman, would you not, that prior to any date with which we are concerned in this litigation the use of condensers, inductances, resistances and batteries in audion circuits was known? A. Yes. Your question is so broad that it certainly can be assented to.

Q. In other words, there is nothing novel in
1692 those instrumentalities as such, in connection with audion circuits? A. Not in the very broad way that you state it.

Q. I intended it to be broad. Will you also agree with me that it was the custom prior to that time—

The Court: Prior to what time?

Mr. Darby: Prior to the earliest date with which we are concerned for the invention of any of the patents here in suit.

Q. (Continuing.) —to use different values for condensers, batteries, inductances, resistances, depending upon the particular use to which the

instrumentalities were put? A. Why, that is a question of electrical engineering, and those things are always adjusted for the purpose that you want to attain. As you state your question you do not make it any different than any other engineering matter. You use them as far as your knowledge permits you to use them.

Q. And that it was known in connection with vacuum tube circuits that different values for inductances and resistances would have different 1694
effects in the circuits in which they were employed? A. Well, that might be a presumption. I do not think your question is answerable.

Q. You know, do you not, that the values of the inductances and resistances in audion circuits differed when they were employed for audio-frequency currents than when they were employed for radio frequency currents? A. If you wanted to accomplish the same purpose you would use a different order of inductance in an audio frequency tuning, for example, from what you would in a radio frequency tuning, of course. 1695

Q. Referring now to B battery supply, varying values of B battery were employed and have been employed since the early days of the audion, have they not? A. Yes, the early audions used to be put out with a variable battery switch, because the audion one day would stand one battery and another day another, and it was necessary often to change the battery to kill the blue haze effect.

Q. Will you please turn to the Arnold patent 1,520,994 in suit, Tab H, and likewise the Arnold patent 1,448,550, Tab F. Both of those patents disclose an impedance numbered 6 in

Arnold patent 1,448,550, and numbered 25 with reference to audion tube numbered 11 in Arnold patent 1,520,994, which impedance is connected in shunt to its associated transformer coil in the input circuit of the audion with which it is connected; is that correct? A. Yes.

Q. Now will you please turn to the Arnold patent No. 1,129,942, Tab No. 10, and also Arnold patent No. 1,129,943, which is Tab No. 11, and
1697 I call your attention to the fact that Arnold patent 1,129,943, Tab No. 11, makes reference at line 100, page 1, to an application for patent identified as "Serial No. 841,568 filed of equal date herewith," and by comparison with the serial number of the application on which Arnold patent 1,129,942 Tab No. 10, issued, I think you can identify that as the application referred to. Is that right? A. Yes.

Q. Do these patents disclose the subject of varying the spacing of the electrodes for the purpose of changing the impedance internal of the
1698 glass envelope? A. Yes.

Q. Now keeping Arnold patent 1,129,943, in mind, is there shown in this patent a thermionic discharge device having a cathode, an anode and a control element; and if so will you give the reference numerals employed to designate them? A. Referring to 1,129,943?

Q. Yes, si.; say Fig. 1. A. The anode is shown at 2, the cathode at 3, and the control element at 1.

Q. And taking any particular vacuum tube, let us say take the one marked 4, has it an input circuit? A. Yes.

Q. That is the circuit that is connected be-

tween the grid and the filament of that tube; is that right? A. Yes.

Q. Has it an outgoing circuit? A. Yes.

Q. And that is the circuit that is connected between the plate and the filament; is that right? A. Yes.

Q. And is there an impedance in that output circuit? A. Yes.

Q. Still referring to the Arnold patent No 1,129,943, is there a source of electromotive force 1700
in the input circuit of the particular tube we have under consideration? A. Yes.

Q. And is there a source of electromotive force in the output circuit of that tube? A. There is.

Q. And is the resistance 8 or the impedance offered by resistance 8 and the battery 9 of a high order? A. The specification, page 2, line 45, says it should be, for example, 100,000 ohms or more.

Q. You would consider that of a high order? A. And in line 44 it is referred to as a high resistance. Well, "high" and "low" are relative 1701
terms, of course.

Q. I notice that you looked through the specification to obtain a value for the resistance. No value can be obtained merely from an inspection of the symbol used in the drawing; is that right? A. That is correct.

Q. Any resistance in the output circuit is bound to have an effect on the output current; is that correct? A. Well, I don't think it is. It is too generally stated to permit of an answer.

Q. I am referring specifically to the Straight Line Characteristic Patent now. That is what I have in mind in this cross examination. If the

resistance 8 was of a low order, what effect would it have on the straight line characteristic of the tube? If it is considerably lower than 100,000 ohms what effect would it have on the straight line characteristic of the tube? A. I don't know. That is a question not determined by the mere absolute magnitude of the external resistance.

Q. What is there in addition to that that you have to know? A. It depends on the relation of
1703 the external resistance under the alternating current path of the impedance, more broadly, as compared to the alternating current-plate circuit impedance within the tube.

Q. Are the tubes as shown in Arnold Patent 1,129,943, repeater tubes? A. Yes.

Q. And they are used as such in the patent? A. Yes.

Q. Now, turn to Patent No. 1,129,942, which is Tab 10; referring to the coupling between the first tube marked 1 in Fig. 6 and the second tube marked 1 in Fig. 6, reading from left to right,
1704 do you agree that the two tubes are coupled together by a resistance coupling? A. No, they are not.

Q. In the normal operation of the arrangement shown in Fig. 6, is there produced potential variations across the left-hand resistance 14? A. They are not—probably not in the sense in which you mean; of course, there are potential variations.

Q. There are potential variations. It is the fact that the resistance as used, makes it unavoidable that there should be some potential variation, is not that correct? A. Yes, that is correct, but that combination of resistance and

condenser is a peculiar one, and what happens in the resistance, depends on what is known as the time constant of the circuit through the upper condenser 18 and the resistance 14 back to the filament circuit.

Q. The resistance 14 is connected between the plate electrode 4 of the first tube to the filament electrode, is it not?

The Court: I don't understand the question. Are you talking about the first tube 1706
on the left now?

Mr. Darby: Yes, your Honor.

The Court: Just read that question.

(Question read.)

A. No, that certainly is not a correct way of describing it in any ordinary use; it is connected between grid 3 of the second tube and a filament 5 of that same tube.

Q. And is there any circuit leading from the plate 4 of the first tube through the resistance 14 to the filament of the first tube? A. Oh, yes, 1707
you can trace all sorts of circuits there.

Q. And I think you just stated that the resistance 14 is also connected between the grid electrode 3 of the second tube and filament electrode of the second tube, is that correct? A. That is where it is connected. That is the significant connection.

Q. All of the circuits are significant, are they not, Mr. Waterman? A. Not necessarily.

Q. They are so shown as complete circuits, are they not? A. You can trace circuits that have absolutely no significance, and a great many more of them in fact, than significant ones.

Q. Irrespective of the significance of them, I am endeavoring now to establish what is shown in this drawing—the circuits that are shown in this drawing. A. You may trace paths—you understand these connections are not circuits. A circuit is something in which the operating current flows, and you can trace various paths in which they do not flow.

1709 Q. Do you mean to say that current does not flow through the resistance 14? A. No, I have explained that the current from the battery 11—or rather the potential from the battery 11 flows through the resistance 14; in other words, 14 is there primarily, and first of all, to enable the charge to be imparted to the grid 3. It is also there to permit a discharge path for the condenser 18, in order that the tube which is the middle tube in Fig. 6, may not block or plug.

1710 Q. It serves exactly the same purpose in the connection that is shown between the middle tube and the tube on the right-hand end; is that right? A. With respect in that instance to the right-hand tube.

Q. Yes. And will you trace the output circuit for the plate electrode 4 of the middle tube for me? A. The direct current circuit of the middle tube is from the battery through the resistance 17 to the plate 4 thence to the filament and back, the alternating current circuit is through the upper condenser 18, the resistance 14, the lower condenser 18 back.

Q. To get the matter perfectly clear on the record, starting from the plate 4 of the middle tube, the output circuit— A. No, I am wrong about that. I was right in the first instance, Mr.

Darby. That is not the alternating current output circuit. The alternating current output circuit is through the reactance 17.

Q. Starting from the plate electrode 4 of the middle tube, will you agree with me that the output circuit starts from that electrode and goes to the point where it branches, part going through the condenser 18, part going through the inductance 17 and part going through the resistance 14 and then back to the filament electrode; will you agree or disagree with that? A. Will you let me have that question read? 1712

(Question read.)

A. Well, that would necessarily be so in any case, but your question goes to something that I had not noticed before. That circuit can be looked at in two ways. I had not discovered that before.

Q. I think you have answered my question. A. You were looking at it in a different way from any way that I had ever looked at it before. I see that it can be looked at in that way. 1713

Q. I thought we were talking at cross purposes and I wanted to get a simple statement. A. Yes.

Q. And of course, you will agree with me that the condenser 18 is connected in the lead between the plate electrode of one tube to the grid electrode of the next tube, will you not? A. Oh, yes, certainly. In either view, that is true.

Q. Now, will you please turn to Colpitts Reissue Patent No. 14,380, Tab 17. Is there there shown a vacuum discharge device of a three-electrode type? A. Yes.

Q. And is there there shown, and if so will you please point out, referring for example to Fig. 2, an inductive coil conductively connected to the input electrodes of the device; I refer primarily to the transformer coil. A. You refer to modulator transformer 14, yes. Wait a minute, no, it is not conductively connected.

Q. The transformer coil 14 is not conductively connected? A. To the input electrodes? No, it

1715 is capacity connected.

Q. And is there a conductive impedance in shunt to that coil? A. No, except through the capacitance.

Q. There is an impedance in shunt to that coil, is there not, namely the resistance 26? A. No, it is in shunt to the coil 14 and the unlettered condenser, which are in series with one another.

Q. So that it is in shunt to the coil and the condenser, is that right? A. Taken together, yes.

1716 Q. And the impedance element 26 is conductive, is it not? A. Yes, certainly.

Q. Now, will you again refer to the Arnold Patent 1,129,942, Tab 10. I think you will agree with me that this patent shows a common source of current for the plate electrodes of all the tubes, will you not? A. It does in certain figures, yes.

Q. Now, referring to Fig. 6, which of the batteries do you understand to be the B battery supply, for supplying voltage to the plate circuit? A. Battery 13.

Q. What is the path of travel of the current from that battery to the plate electrode 4? A.

Through the reactance 17, across the tube to the filament and back to the negative end of the battery.

Q. And that reactance 17, do you understand that to be a series inductance? A. I have been taking it to be the coupling reactance, so of course, it is a series inductance.

Q. And the series inductance is bridged by condenser 18 and resistance 14, is it not? A. That combination constitutes a high resistance 1718
path around the reactance 17, yes.

Q. Now, will you please turn to Tab 23, which is Von der Bijl Patent No. 1,350,752. You will agree with me, will you not, that what you understand to be the invention of Arnold Patent 1,520,994, as defined in the claims of that patent in suit, is illustrated in Fig. 4 of the Van der Bijl patent, in so far as the potentiometer 10 is concerned? A. There is such a potentiometer in the input circuit. It is not in that case, however, the sole source of voltage in the input circuit and its use is for quite a different pur- 1719
pose.

Q. Then turn to Kendall Patent 1,330,471, which is Tab 20. Will you agree with me that the invention defined in the claims of the Arnold patent in suit No. 1,520,994 is completely illustrated in the potentiometer 84 of Fig. 4? A. It seems to be, yes.

Q. Now, will you please turn to the De Forest Patent 841,387, Tab No. 1; is it not true, with respect to this De Forest patent, as well as De Forest Patent 879,532, Tab No. 2, and De Forest Patent 995,126, Tab No. 4, that wherever there is illustrated a three-electrode audion device,

1720 the control electrode is connected to the negative side of the filament battery?

The Court: Can you substitute for "control electrode," the word "anode"?

Q. Control or grid electrode. The control electrode is the grid electrode and is always connected to the negative side of the filament bat-
1721 tery, is that true? A. No, that is not true.

Q. Show me any instance where it is not true, will you? A. That is not true of either figure in Patent 879,532, and it is not true in 995,126.

Q. In no figure, did you say? A. Yes.

Q. All right, let us take Fig. 2 of De Forest Patent No. 841,387; you understand electrode D^1 is the control electrode? A. I did not say anything about 841,387. I was just coming to that. In 841,387, the control electrode, which is not a grid, but is the plate D^1, and is in a circuit through the detector T^{11} to the negative side
1722 of the filament E.

Q. Then you disagree with my statement. What is the control electrode in Fig. 3 in this patent? A. Of 841,387?

Q. Yes. It is the device *a*, is it not?

The Court: That is small *a*?

Mr. Darby: Small *a*, yes, your Honor.

The Witness: No, there is not any control electrode in that case.

Q. Isn't that device *a* the control electrode to which the input electrode is connected? A. No, it is a mechanically operated device in which

the filament is jerked back and forth with reference to plate D.

Q. Take Fig. 4 on the next page, that is a three-electrode device, is it not? A. Yes.

Q. Which is the control electrode? A. D^1.

Q. To which side of the filament battery is the control electrode connected? A. Neither side.

Q. Is there not an input circuit between the grid and filament? A. The circuit is connected to the negative side, but the control element is 1724
not.

Q. I will restate my previous question, and maybe we will agree. Is it not a fact, in every instance in these three De Forest patents that I have mentioned where three-electrodes are employed, one of which is a control or grid electrode, that there is a circuit connecting the grid electrode to the negative side of the filament source? A. No, you are wrong there, unless you limit your question so as to exclude a direct current connection; otherwise you are making a misleading statement in your question. 1725

Q. I said "circuit connection," adopting your own language, just a minute ago. A. All right, and I made my answer clear. If I did not, then I was at fault. The circuit connects through a condenser, therefore, so far as imparting any bias to the control electrode is concerned, it just does not.

Q. Mr. Waterman, you realize that I have not asked you anything about bias, do you not? A. I know you haven't, but I know what you are cross examining about, and as I said in my direct examination, these are the customary circuits. It was customary at that time to put the

signal between the control element and the negative side of the battery.

Q. Now, will you please endeavor to answer my questions rather than anticipate why I am asking them, and I think we will make much better progress. Will you answer my question now. Is it not a fact that in every one of the circuit diagrams illustrated in the De Forest patents where three electrodes, one acting as
1727 a control or grid electrode is employed, that the grid or control electrode is connected by a circuit, irrespective of whether it is direct current or alternating current, to the negative side of the filament battery? A. No, that is not true.

Q. All right, take No. 841,387, is it true with respect to that Fig. 4? A. It is not true, irrespective of what kind of current you are talking about.

Q. Is there a circuit connection between the electrode D1 and the filament in Fig. 4 of De Forest Patent 841,387? A. No.

1728 Q. There isn't any circuit connection between them at all? A. No, your question is limited, irrespective of AC or DC, and if so, your statement is not correct.

Q. Just forget everything that has gone in the past and answer me this question: Is there a circuit connection between the electrode D1 of Fig. 4 of De Forest and the filament of the tube? A. There is an alternating current circuit.

Q. There is a circuit connection? A. There is an alternating current circuit. There is no direct current circuit.

Q. Is an alternating current circuit, a circuit,

in your opinion? A. It is one of a number of types of circuit.

Q. Therefore it is a circuit? A. It is an alternating current circuit, yes.

Q. Now, turn to De Forest Patent No. 879,532; is there a circuit between the plate electrode A, Tab No. 2, and the filament electrode in that tube? A. An alternating current circuit, yes.

Q. Is that connection made to the negative side of the battery that heats the filament? A. 1730
Yes.

Q. Look at the figure below, Fig. 2. A. The same is true.

Q. Is the same true of all the other circuits of the De Forest patent, tab No. 4, Patent No. 995,126? A. Referring to the tubes A^1—yes, there is an alternating current circuit connected to the control electrode and to the negative side of the filament.

Q. Your answer is based upon the fact that in each instance the patent designates the polarity of the battery for heating the filament, is that 1731
right? A. Yes.

Q. Now, do you know why in these various audion circuit arrangements that we have been discussing—referring to these De Forest audion circuit arrangements—all these De Forest patents—the connection of the circuit between the grid and the filament was made to the negative side of the filament battery? A. I do not know anything about De Forest's mental operations, if that is what you mean. The art started that and continued for a long period. As far as I know, it is generally true today.

Q. Referring to De Forest Patent No. 841,387

again and particularly Fig. 2, I think you referred to the device marked T^{11} as an oscillation detector. Did all oscillation detectors require sensitizing current, and if not, what types did not? A. Well, prior to the date of the application for the patent in suit, as far as I know, most of them did. Whether there are any that did not up to that date, I do not recall.

1733 Q. Crystals, other than carborundum do not require sensitizing? A. As far as I remember, carborundum was the only crystal that was available at that time, but I would not want to be too sure of my memory.

Q. You testified as an expert in the case of crystal detectors, did you not? A. Yes, I did. I have quite forgotten the date, but my recollection is that the carborundum crystal was the only one that was available that was actually worked in the art, until a little later.

Q. You do not recall that you testified that crystal detectors were available prior to 1907?

1734 A. No, but if you will let me see—

Q. I am asking for your recollection. A. I want to know what the facts are.

Q. All right, I will enlighten you on that. I can give you one that might refresh your recollection, the silicon detector, don't you recall that was used in 1906? A. No, I would not be able to recall that, because I was not working in the art then. The first silicon detector I had was provided with a battery for sensitizing it, but I do not recall getting that until much later.

Q. During the recess, I will refresh your recollection, Mr. Waterman. I have no intention of

misleading you on it. Where a sensitizing battery was used, was current flow necessary? A. In every case that I know of, yes.

Q. Have you ever heard the expression of a "floating grid" in connection with these vacuum tubes? A. Oh, yes. All the early use was by floating grid.

Q. What is meant by that? A. It means that there is a condenser in the path to the grid from the input source, whatever that may be, 1736 so that the potential of the grid floats, as the expression is, with reference to the filament. It is then determined in the absence of any signal,—it is determined by what are termed by contact and maybe anywhere from a volt or so positive to a volt or so negative and when it is connected to a source of signal, then the potential will fluctuate in accordance with the signal and whatever the cumulative effect of the condenser in the lead may be.

Q. You are familiar with J. H. Morecroft; you know him, do you not, Professor Morecroft? 1737 A. Yes, he died a short time ago, and I was very sorry to hear it.

Q. He is considered an authority in the radio science, is he not? A. Oh, yes.

Q. He was Professor at Columbia University of electrical engineering? A. Yes.

Q. Are you familiar with his book, "Principles of Radio Communication"? A. Yes.

Q. With respect to this question of the floating grid—first let me ask you this: All of the early type of audion tubes such as you produced from your collection were generally known as the old De Forest type, is that right? A. That is right.

Q. And they were all very gassy, I think you have testified, that is, they did not have a high degree of vacuum. A. The vacuum varied very greatly, and when they were new, none of them had very high vacuum.

Q. Let me read this to you from Professor Morecroft's book, with which you expressed familiarity:

1739 "In Fig. 27 is shown a set of plate-current curves from an old De Forest audion, after it had been re-evacuated to take off all possible gas. The plate circuit had no added resistance except that of the B battery, which was so low that the variation in plate current did not appreciably affect the plate potential. On the curve sheet is shown the locus of the 'free grid potential,' i. e., the potential at which the grid set itself when its external terminal was completely insulated. This point will be taken up more in detail later."

1740

Then he goes on:

"For the tube used in getting the curves of Fig. 27, it will be noticed that the grid voltage was more effective (in controlling the plate current) than the plate voltage in the ratio of about two to one."

He then gives some mathematical formulae that I do not think it is necessary to read. Do

you disagree with that statement of the matter of the floating grid? A. I do not see anything to disagree with, Mr. Darby. I could not disagree with him; I did not perform his tests.

Q. Do you see anything scientifically wrong in his statement, or the results illustrated by the curve that he refers to? A. No, he has taken an old audion and gotten something that nobody ever did with one of the originals. He got a consistent set of curves out of it. 1742

Q. And you notice he said in there, "insulating the grid," that is the type of insulation that you referred to with reference to the De Forest patent, where you pointed out that the grid was insulated from the condenser by a grid filament lead, is that right?

Mr. Ashton: Would you mind stating what the date of the publication of the book is?

Mr. Darby: Not a bit. This particular book that I am reading from was copy- 1743
righted in 1921 and it is dated April, 1921, Columbia University, Professor Morecroft.

Q. You made reference to the De Forest audion and Dr. De Forest. You are familiar, are you not, with an article by Dr. Lee De Forest: "THE AUDION. A New Receiver for Wireless Telegraphy," presented at the 210th meeting of the American Institute of Electrical Engineers, October 26, 1906? A. Yes, I have seen the article.

Q. I think I have had the pleasure of dis-

cussing it with you across the witness stand before. In this article there is contained this statement, which I will read, and you may check my reading:

"The manner in which the audion should be located in the oscillating circuit, as well as many other considerations, shows conclusively that it is a 'potential-operated' rather than a 'current-operated' relay receiver. At the same time its advantageous sluggishness of action, as explained above, renders it additive in its response to the energy of an entire wave-train or even of a series of wave-trains. Hence its excellent and marked selective qualities."

1745

Do you agree with that statement? A. I will have to look at the article. I think he is referring to the condenser action, is he not?

1746 Q. No, I was under the impression that he was referring to the operation of the tube; it may be to the condenser, but it is immaterial from my point of view. A. I do not know what he means by its advantageous sluggishness of action. I would have to read the article to find that out. I think he is referring to the detection phenomenon there, Mr. Darby. He uses the word "sluggish" I imagine in the sense that we ordinarily use the word integrating action.

Mr. Darby: That completes my cross-examination of Mr. Waterman. I will either at this time, or at a more appro-

priate phase of the case, will offer in evidence a reproduction of the curves referred to in the Morecroft book. May I do it now?

The Court: If there is no objection.

Mr. Ashton: None.

Mr. Darby: I would like to offer in evidence copy of the curves referred to as Fig. 27 in the passage of Professor Morecroft's book just read to the witness, and 1748
I understand that I will be permitted to substitute a photostatic copy for the book.

(Marked Defendant's Exhibit N.)

Re-direct Examination by Mr. Ashton:

Q. I have only one question to ask: Whatever De Forest may have been referring to as potential operation, in the article referred to by Mr. Darby, is what is meant by potential operation defined by Lowenstein in his patent? A. Yes, namely, a condition in which the grid circuit 1749
does not take energy from the line.

Q. Does Lowenstein refer to that operation as ultra-negative potential operation? A. He does.

FRANKLIN T. WOODWARD, recalled, testified further as follows:

Direct Examination by Mr. Ashton:

We made investigations of the De Forest patents for a long time, but the particular one that

1750

I have in mind, and I think what you referred to was in 1927. We made an investigation of the De Forest patents including two Ries patents and reported to Mr. Otterson.

Q. And what was your report?

Mr. Darby: What is the relevancy of this, may I ask?

Mr. Ashton: The relevancy is this: The

1751

witness Otterson who testified yesterday, as a result of an objection which does not appear in the record, that this reported study of the De Forest patent was made and the results were reported and the Western Electric Company was not interested. Mr. Schlesinger states that he had this interview in which these patents were discussed and I wanted to bring out that the Electrical Research Products and Western Electric Company were not interested, as such, in the De Forest patents.

1752

Mr. Darby: I do not think that that bears on this case at all. It is not the De Forest patents that are on trial.

Mr. Ashton: I think the point is, if your Honor understands—

The Court: I think I do, and I think I will sustain the objection with exception.

A suit was brought against the Stanley Company, which we defended.

Mr. Darby: That is stipulated.

The Court: The Western Electric Company defended the suit against the Stanley Company?

Mr. Ashton: Yes, the title of the suit was General Talking Pictures Corporation and De Forest Fonofilm vs. Stanley Company of America.

Mr. Darby: That is all stipulated.

Q. One further question: Did the court hold that any of the patents were infringed?

Mr. Darby: Just a minute. I have given 1754
the Court citation of the authorities. Why ask this witness. It is a public record; it is in the Federal Reporter.

The Court: Are any of the patents here in suit involved?

Mr. Ashton: No, they are not. The De Forest patents which Mr. Otterson was talking about—

The Court: That is a matter that can be ascertained by looking at the cases, is it not?

Mr. Ashton: That is quite agreeable to 1755
me, your Honor. That is all.

Mr. Darby: I have no questions.

Mr. Neave: I think if Mr. Darby will make a stipulation we need not offer these documents.

Mr. Darby: It is stipulated that it is common practice where a patented invention is applicable to different uses, to grant written licenses to manufacturers under United States Letters Patents restricted to one or more of the several fields of use permitting the exclusive or non-exclusive use of the invention by the

licensee in one field and excluding its use in another field. I stipulate that and I urge, however, objection to its receipt for any evidential purpose, as irrelevant and immaterial what the common practice is, on the issue of law as to whether or not it is legal.

The Court: That goes strictly to the question of the effect to be given to the
1757 stipulation, but not the capacity of counsel to stipulate to a fact.

Mr. Darby: Yes, you are right.

The Court: That is all we are talking about now.

PAUL H. PIERCE, called as a witness on behalf of the Plaintiffs in Rebuttal, being duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

1758

My name is Paul H. Pierce. I reside at 417 Highland Avenue, Westfield, New Jersey. I am employed by Electrical Research Products, Inc., as an engineer in the engineering department. I entered the employ of the Western Electric Company in July, 1911.

As to what work I did under Dr. Harold D. Arnold's direction, in the design of vacuum tubes, and their characteristics and use, in the latter part of 1912 and during all of 1913 I worked on the characteristics of vacuum tubes under Dr. Arnold. This work involved the determination of input and output impedance of

tubes. I had to do with their operation in circuits to obtain maximum power output. I made tests for that purpose.

I first learned that a 3-electrode vacuum tube had impedance in the Fall of 1912. I learned it from Dr. Arnold. I first learned that the impedance of the output circuit of a 3-electrode vacuum tube might be matched to the impedance of the work circuit in the Fall of 1912, from Dr. Arnold. I did work under Dr. Arnold's 1760
direction for the purpose of determining under what conditions a tube would give maximum power output. I carried out experiments which have been recorded in my notebook for that date, for that period, in which I made measurements of circuits and the output of vacuum tubes, and measured the power into those circuits. I found that the power output was maximum when the external impedance was matched by the impedance of the tube. I can fix the date by this memorandum. This is my own memorandum dated December 18, 1912. I prepared it 1761
on this date, December 18, 1912. The data and definitions given in this memorandum on pages 1 and 2 show that I was dealing with the alternating current impedances and currents within the vacuum tube.

Mr. Ashton: I offer the memorandum in evidence as Plaintiffs' Exhibit 43, and ask that a copy be substituted.

(Marked Plaintiffs' Exhibit No. 43.)

All during 1913 I made tests under Dr. Arnold's direction on audions having different

types of grid structures, and different spacings of the elements therein. The Research Department made several tubes in 1913 which differed from the De Forest tubes as to geometry. It made a tube given the number 39. If I may refer to my notebook I can describe it more in detail. This tube had two plates, two grids and one filament. One grid on one side of the filament was a large loop, the one on the other side
1763 of the filament was a small loop. This is shown in a picture in Book No. 36 on page 53.

The Court: Can you give the date?

I have entries of my own in that notebook. In this book I find entries of my own on page 80. The first one I find is on page 69, dated October 23, 1913. On page 190 of my notebook 20 I find a record dated October 2, 1913, of new audions, made September 30th and October 1st, one of which is this same audion No. 39. This Book 20
1764 was kept by me.

Mr. Ashton: I offer in evidence page 190 of the witness' notebook 20, page 53 of notebook 36, and page 59 of notebook 36, as three exhibits.

(Marked Plaintiffs' Exhibits Nos. 44, 45 and 46.)

The grid or grids of this tube 39 has a very open structure. It would reduce the impedance of the tube. The side having the larger grid opening would have the lower impedance.

I could compare this tube 39 with tube No.

7-A, which was a De Forest type tube, and the data on which was recorded in my Book No. 20, on pages 32, 33, 34 and 35. I would have to take a particular voltage for each tube which was comparable. I find for audion No. 39, which is the one with the large grid opening. I find that with a plate voltage of about 20 volts and a grid potential of zero, the space current was 1,460 micro-amperes. In the typical De Forest audion No. 7-A which was recorded on pages 34 1766
and 35, under the same conditions of voltages on the plate and grid the space current was 310 micro-amperes.

I got this tube 7-A from the McCandless Company, I think, who manufactured the tubes, the De Forest tubes. Tube 39 and other Western Electric tubes were made and designed under Dr. Arnold's direction. I measured other tubes in which the separation between the grid and filaments was different. I can fix the date of such measurements as in December, 1913. We made such measurements. I find a record of one 1767
tube on December 15, 1913, tube No. 158, which is recorded on page 16 of Book No. 50. It shows a diagram of a spacing in this tube in which the plate and grid spacing on one side was different than the spacing of the grid and plate on the other side of the filament.

Mr. Ashton: I offer in evidence this page 16 of Notebook 50, which relates to audion No. 158.

(Marked Plaintiffs' Exhibit No. 47.)

I also worked on audions having different grid meshes.

1768 Drawing ES111730, dated January 6, 1914, is a curve which I worked on. This is a curve taken from the data on page 56 of Book 50. It shows the characteristics obtained with two vacuum tubes, one of which had a grid wire mesh of six wires in one direction and four in the other, and another one with three wires in one direction and three in the other, as shown on the curve.

1769 Mr. Ashton: I offer pages 56 and 57 of Notebook No. 50 in evidence as Plaintiffs' Exhibit 48.

(Marked Plaintiffs' Exhibit No. 48.)

Mr. Ashton: I offer in evidence sketch ES111730, dated January 6, 1914, as Plaintiffs' Exhibit 49.

(Marked Plaintiffs' Exhibit No. 49.)

I made this sketch last referred to at the time it is dated. The tubes referred to on the sketch
1770 ES111730 were made under Dr. Arnold's direction. The conclusions as to the effect on the output impedance of these two structures of the grid meshes were that the output impedance of the tube having the larger grid mesh was the lower.

Those were not the only tubes that we experimented with. We experimented with a great many having different types of grid meshes and different spacings during that time. I made measurements to determine the relation of the tube impedance to the load impedance. I can fix the date of such measurements. I find in February, 1913, a sketch which I made at that

time, on page 73 of Book No. 20. This gives a lot of data obtained in measuring the input impedance of a vacuum tube No. SS, and also data giving the output impedances and the circuit in which this data was taken. The circuit appears on page 73.

Mr. Ashton: I offer in evidence page 72 of Notebook 20 as Plaintiffs' Exhibit No. 50. 1772

(Marked Plaintiffs' Exhibit No. 50.)

Mr. Ashton: And page 73 of the same notebook, as Plaintiffs' Exhibit 51.

(Marked Plaintiffs' Exhibit No. 51.)

This memorandum dated March 15, 1914, is a memorandum in Dr. Arnold's handwriting, which I understand came from his files. It was obtained from the Bell Laboratories files. It is dated March 15, 1914. The lower curve on page 4 shows a straight line characteristic. This curve was obtained on a vacuum tube with a resistance in the plate circuit. 1773

Mr. Ashton: I offer the memorandum in evidence as Plaintiffs' Exhibit 52.

(Marked Plaintiffs' Exhibit No. 52.)

This is a memorandum which I wrote on March 19, 1914, in my own handwriting. The date 1913 appearing at the top is an error. It was 1914. The complete date was March 19, 1914. The subject of this memorandum is experimental audions. It has sub-headings of Grid Distance, Grid Opening, and is a record of work

which I did at that time under Dr. Arnold's direction. I made the report to Dr. Arnold. That had to do with results obtained with different grids.

Mr. Ashton: I offer in evidence the memorandum last referred to by the witness, of March 19, 1914, as Plaintiffs' Exhibit 53.

1775 (Marked Plaintiffs' Exhibit No. 53.)

This is a memorandum which was prepared by Mr. Arnold, addressed to Mr. Colpitts, dated April 17, 1914, which describes audion amplifiers without transformers. This memorandum discloses in the drawings a common plate supply. I recognize the writing at the bottom, below the figures. This is Mr. Arnold's writing. Professor Arnold's. The common plate supply is marked V^1. The battery is V^1. There are three tubes supplied by battery V^1.

1776 Mr. Ashton: I offer the memorandum in evidence as Plaintiffs' Exhibit No. 54.

(Marked Plaintiffs' Exhibit No. 54.)

Dr. Arnold developed vacuum tubes, so that they would amplify telephonic currents without distortion. The tubes which he developed would permit the use of smaller gauge and less expensive transmission lines than would otherwise have been required. They undoubtedly resulted in economies in long distance transmission. In addition to high vacuum, Dr. Arnold recognized the existence and the importance of

the space-charge effect of electrons in the high vacuum tube. He calculated the magnitude of this effect and methods for its adaptation to commercial purposes.

Q. Did he develop theories as to means of obtaining proper physical—

Mr. Darby: Just a moment, this is fact testimony of such a nature, that I must request that you do not lead the witness 1778 on this.

Mr. Ashton: These particular questions are not specific with regard to the particular invention, but merely the broad work which Dr. Arnold did on the vacuum tube. The questions regarding the exact dates of these inventions, have already been answered.

Mr. Darby: Yes, I understand, but let the witness testify to these things.

Mr. Ashton: I am trying to make as much time as possible. 1779

The Court: Mr. Darby speaks as one in authority when he makes an objection on that ground in these matters.

By Mr. Ashton:

All of Dr. Arnold's work led up to the design of vacuum tubes so that they could be manufactured with accuracy. So that their characteristics could be reproduced. He studied the static characteristics of the audion and I assisted him in much of this work. I was one of his special assistants at the time he was doing this work.

He had some others, Mr. Nicolson, Mr. Van der Bijl—those were the two outstanding men in his group; there were others. Dr. Arnold advocated the use of the vacuum tube as a research tool.

I am a member of the Acoustical Society of America. The Acoustical Society of America, after Dr. Arnold's death, passed a resolution in appreciation of his work on acoustics. Dr.
1781 Arnold died in August, 1933.

Cross Examination by Mr. Darby:

One of the objects, I believe, of Dr. Arnold's research as to vacuum tubes, was to produce a relay that could be utilized as a relay repeater in connection with transcontinental and transoceanic communication. Mr. De Forest brought his audion to us. Up to that time we had not used vacuum tubes, as a relay or repeater in our telephone lines. We used the Shreve repeater.
1782 And the Shreve repeater was a mechanical repeater, and had a little moving part in it. The audion is an inertialess device. Wherever you have a repeater that has a moving part, you are most apt to cause distortion in the currents that are received and relayed. When you say that the audion is an inertialess device, I understand you to mean that it has no moving parts in its operation.

Consequently in using an audion as a relay or repeater, there is no chance for distortion to creep into its operation, due to any movement of any of its parts,—in any of its mechanical parts. It is advisable in telephone practice to

note accuracy or impedance of every instrumentality that is out any place included in the telephone line. I believe it has been standard practice of the Telephone Company to make a thorough investigation of the impedance in anything that is used in its line. The reasons we made such an exhaustive study of the impedance factors of the vacuum tube, in preparing for its use in telephone lines, was in order to determine the elements of the tube, so that they could be 1784 used for this purpose, in telephone practice.

The impedance of any device does not vary in accordance with its geometrical construction. The factors that determine the difference in impedance of the various instrumentalities are wire.

As to whether, with the exception of wire, the impedance of any device varies, in general, with its geometrical construction, well, it seemed to me it only applied to vacuum tubes in particular. It does not to mechanical devices to any great extent. Taking up the particular instance that 1785 I gave, of wire, the variation of its impedance in accordance with its diameter is one of the factors. Diameter, I consider one of the geometrical features of the wire. Composition is another, and the impedance will vary in accordance with the composition of the wire.

The ordinary microphone, included in the circuit,—the mouthpiece, to give it a more popular name,—its impedance undoubtedly varies in accordance with the size of the wire that is used in its construction, the strength of the magnet, the size of the magnets.

As to whether the same was generally true

and whether it is not a fact that I knew it at the time I started my investigation of the audion, that the impedance of practically every instrumentality used in telephone practice differed in accordance with its geometrical construction, well, as I say, the geometry of some resistance elements and inductance elements and capacity elements depended on its geometry.

1787 Mr. Ashton: I offer in evidence Cloud Patent No. 1,907,741 of May 9, 1913.

(Marked Plaintiffs' Exhibit No. 55.)

Mr. Ashton: And I offer in evidence Cloud Patent dated June 28, 1932, No. 1,864,890.

Mr. Darby: I object to these patents as exhibits. They are not relevant or material to any issue in the case.

The Court: I think Mr. Cloud testified concerning this patent.

Mr. Ashton: He testified concerning it,

1788 and that is the reason we want it in the record, your Honor. It is the patent, you recall, he said was used to get around the Lowenstein inventions.

The Court: I do not remember his exact words; I do not know that they were just in that form, but I think I know what you are talking about. Objection overruled, and exception.

(Marked Plaintiffs' Exhibit No. 56.)

Mr. Ashton: I offer in evidence the file history of Lowenstein Patent No. 1,231,764.

(Marked Plaintiffs' Exhibit No. 57.)

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Mr. Ashton: File history of Mathes Patent 1,426,754.

(Marked Plaintiffs' Exhibit No. 58.)

Mr. Ashton: File history of Arnold Patent 1,329,283.

(Marked Plaintiffs' Exhibit No. 59.)

Mr. Ashton: File history of Arnold Patent 1,403,475.

(Marked Plaintiffs' Exhibit No. 60.)

Mr. Ashton: File history of Arnold Patent 1,448,550.

1790

(Marked Plaintiffs' Exhibit No. 61.)

Mr. Ashton: File history of Arnold Patent 1,465,332.

(Marked Plaintiffs' Exhibit No. 62.)

Mr. Ashton: File history of Arnold Patent 1,520,994.

(Marked Plaintiffs' Exhibit No. 63.)

Mr. Ashton: The file history of Arnold Patent 1,504,573, for use in connection with Patents 1,403,475; 1,448,550; 1,465,332 and 1,520,994. The reason for that is that this is the original application on which each of those were based.

1791

(Marked Plaintiffs' Exhibit No. 64.)

Mr. Ashton: The Arnold Patent in suit 1,329,283 is based upon the file history of patent or application for patent 1,129,942, so I offer in evidence the file history of that patent 1,129,942 as Plaintiffs' Exhibit 65.

(Marked Plaintiffs' Exhibit No. 65.)

Mr. Ashton: I offer application Serial No. 59,210 filed November 2, 1915, which is an original application upon which Patent 1,448,550 was based.

(Marked Plaintiffs' Exhibit No. 66.)

Mr. Ashton: I offer in evidence the RCA tubes, cartons and notices for the tubes 201-A, as Plaintiffs' Exhibit 67.

(Marked Plaintiffs' Exhibit No. 67.)

Mr. Ashton: No. 227.

(Marked Plaintiffs' Exhibit No. 68.)

Mr. Ashton: No. 226.

(Marked Plaintiffs' Exhibit No. 69.)

Mr. Ashton: No. 250.

(Marked Plaintiffs' Exhibit No. 70.)

1793 Mr. Ashton: 280.

(Marked Plaintiffs' Exhibit No. 71.)

Mr. Ashton: 281.

(Marked Plaintiffs' Exhibit No. 72.)

Mr. Ashton: I also offer in evidence American Transformer license plate previously marked for identification as Plaintiffs' Exhibit 30.

(Plaintiffs' Exhibit No. 30 for identification received in evidence.)

Mr. Ashton: I offer in evidence photograph of General Talking Pictures "Amer

1794 Tran" amplifier previously marked for identification Plaintiffs' Exhibit 31.

(Plaintiffs' Exhibit No. 31 for identification received in evidence.)

Mr. Ashton: I offer in evidence letter of General Talking Pictures Corporation to American Transformer Company, dated November 17, 1928, previously marked for identification as Plaintiffs' Exhibit 32.

Mr. Darby: I have no objection.

(Plaintiffs' Exhibit No. 32 for identification received in evidence.)

Mr. Ashton: I ask that copies be substituted for the originals.

1795

Mr. Darby: No objection.

Mr. Ashton: I offer in evidence letter of American Transformer Company to the General Talking Pictures Corporation of November 23, 1928, previously marked for identification Plaintiffs' Exhibit 33.

Mr. Darby: I object to this on the ground that it is secondary, in that it is a carbon copy and it is incomplete. The papers referred to therein are not attached. We offered to Mr. Ashton for his 1796
use the original, with the papers attached to it.

Mr. Ashton: There is no objection to including in the offer the circular of the American Transformer Company which was attached to the original letter.

The Court: All right, it is understood that the original letter is being offered as Plaintiffs' Exhibit 33, is that it?

Mr. Darby: Yes, your Honor, substituting a photostat copy.

Mr. Ashton: We do the same with the 1797
attached circular; we will make a photostatic copy of it.

Mr. Darby: We will furnish the photostats.

(Plaintiffs' Exhibit No. 33 for identification received in evidence.)

Mr. Ashton: I offer in evidence as Plaintiffs' Exhibit 34, photograph of the license notices attached to the defendant's amplifiers previously marked for identification.

Mr. Darby: No objection.

(Plaintiffs' Exhibit No. 34 for identification received in evidence.)

Mr. Ashton: I offer in evidence the General Talking Pictures contract referring to the Strand Theatre, previously marked for identification as Plaintiffs' Exhibit 35.

Mr. Darby: May I ask what its relevancy is?

Mr. Ashton: It is relevant on several grounds. In the first place, it has been testified to by the witnesses and secondly it gives the price of the apparatus, which
1799 —— is an important consideration, your Honor, the price of the defendant's apparatus was $1,250, and that comes in on the license matter.

The Court: What is the date of that?

Mr. Ashton: The date of it is February 20, 1929.

Mr. Darby: I object to it as irrelevant and immaterial.

The Court: I am afraid I have forgotten it now. I don't think I saw it. Oh, yes, I recall now. This was that Allentown
1800 theatre.

Mr. Ashton: The one we discovered in April.

The Court: I think Mr. Schlesinger identified this as being an authentic contract.

Mr. Darby: I do not raise any question about its authenticity, but I do not see how it is relevant or material.

The Court: It may not be, but it won't be alone in that regard.

(Plaintiffs' Exhibit No. 35 for identification received in evidence.)

Mr. Ashton: I offer in evidence as one

exhibit a group of ten photographs of the defendant's amplifiers, which shows the back as well as the front of the amplifiers, and where the notices appear. 1801

(Marked Plaintiffs' Exhibit No. 73.)

Mr. Darby: I may want an opportunity to verify this, your Honor.

The Court: Surely.

Mr. Ashton: I offer in evidence bulletin of the De Forest Radio Telephone and Telegraph Company No. B14 of 1914, which appears at page 130 in the book of plaintiffs' exhibits in the High Vacuum Case, with respect to the license matter. This bulletin shows that the De Forest Company placed upon its amplifiers exactly the same sort of restricted notice that is involved in this case here. 1802

The Court: And you draw what conclusion from that?

Mr. Ashton: That it has been used by other people.

The Court: Was it not stipulated this morning that that had been common practice? 1803

Mr. Ashton: It was not stipulated that these notices had been used, your Honor, at all. It was stipulated that it was common practice to enter into written license agreements.

The Court: You want to see how that was administered?

Mr. Ashton: Yes, this was an early instance of the De Forest Company putting out these audion amplifiers, right after they began to go into the market, and

this was admitted that this was put out by the De Forest Company itself; it went into the record, you see, in the High Vacuum Case.

Mr. Darby: On an entirely different basis. I thought I finished that High Vacuum Case once. Your Honor will understand that fundamentally the De Forest Radio Company is not connected in any way with this case.

1805 The Court: I realize that. This company is a sort of predecessor of it though, isn't it?

Mr. Darby: No, it is not connected with it at all. The only link-up with it is that Lee De Forest, the individual, who started the De Forest Radio, is a consulting engineer with this company. Dr. De Forest for a great many years devoted his time exclusively to radio.

The Court: Can't you accomplish your purpose by reading into the record what

1806 this notice is?

Mr. Ashton: The bulletin referred to contains the following license notice:

> "De Forest Audion License for private, amateur or experimental use only. The only audion detector manufactured for the use of amateurs under the protection of the patents of Dr. Lee De Forest."

Mr. Darby: I object to its use, for the sake of the record, your Honor.

The Court: All right, I overrule the objection and exception.

1807

Mr. Ashton: I offer in evidence the letter of Walter S. Gifford, President of the American Telephone and Telegraph Company to Mr. Edgar S. Bloom, president of the Western Electric Company, dated November 6, 1926, which is a letter granting certain rights of the Telephone Company to the Western Electric Company, and that has to do with the subject matter which the witness has testified to as to their right and authority.

1808

Mr. Darby: May I read that letter?

Mr. Ashton: Yes. It is in the chain of title alleged in the bill.

Mr. Darby: We do not question the chain of title. We do object to it as immaterial. Is there any issue on title?

Mr. Ashton: No, there is no issue on the chain of title, but there is a question of right between the Western Electric and Electrical Research Products,—

The Court: Does this add to or detract from their contracts?

1809

Mr. Ashton: We show what the rights were. We show that the Western Electric and Electrical Research Products could not have furnished rights to the defendant.

The Court: And therefore?

Mr. Ashton: Therefore it has a direct bearing on the testimony of the witnesses, that they made no statements to Mr. Schlesinger.

The Court: All right.

Mr. Darby: I object to it as irrelevant and immaterial.

The Court: Overruled and exception.

(Marked Plaintiffs' Exhibit No. 74.)

The Court: That is a letter written November 6, 1926, is it?

Mr. Darby: Yes, your Honor.

Mr. Ashton: And I offer in evidence the other agreement granting licenses to Western Electric and Electrical Research

1811 Products, dated May 7, 1929, for the same purpose.

Mr. Darby: The same objection.

The Court: Same ruling and exception.

(Marked Plaintiffs' Exhibit No. 75.)

Mr. Ashton: I offer in evidence the contract license agreement between Radio Corporation of America and Raytheon Manufacturing Company, dated March 19, 1929, which is the company defendant testified from which it purchased vacuum tubes.

1812 Mr. Darby: I object to the receipt of the license. I read into the record the license notice that was in the agreement and I submit that serves this purpose.

The Court: Is there any question that Raytheon tubes were sold under restricted licenses, and they could be sold under the terms of the notices?

Mr. Ashton: The notice does appear in the record, but the entire contract does not. I offer the contract simply for the sake of the completeness of the record. I do not press it if there is any serious objection.

1813

The Court: All right.

Mr. Ashton: I offer in evidence the draft letter of American Transformer Company to General Talking Pictures Corporation of July 3, 1929, previously marked for identification as Plaintiffs' Exhibit 29.

Mr. Darby: I object to that. I don't know what its purpose is. Certainly its origin has not been established.

1814

Mr. Ashton: Your Honor will recall the discussion and the arrangement that was made at the time that the offer would be withdrawn at that time and I stated that the letter would be re-offered at a later stage in the case. I think the basis for the receipt of the letter has been established.

The Court: You think the authenticity of the letter has been established?

Mr. Ashton: It has been established definitely that the letter did not originate with the American Transformer Company.

1815

The Court: Assume that that is so: That leaves about 90 degrees on the horizon uncovered, doesn't it?

Mr. Ashton: It shows it was something submitted from the outside; it originated from the outside.

The Court: And therefore?

Mr. Ashton: And therefore it should be received. If there is any objection to it on the ground that it came from the files of the American Transformer Company and was not prepared by them,—I think that has already been established that it

was not prepared by them,—we can prove it came from the files of that company. I don't think there is any question though that it did.

The Court: Mr. Ashton, is it not pretty well conceded by everybody connected with the transaction that those two letters Exhibits J and K, I think, had their origin in conversations that perhaps were carried on as many as three times, and that
1817 it was the desire of both parties to be precise in stating the exact representation. That much is clear, isn't it?

Mr. Ashton: I think it is, your Honor.

The Court: Now, does it greatly matter whether there was another unattached literary production?

Mr. Ashton: I think this shows the origin of the whole transaction.

The Court: If there was anyone who could identify the pencil notations, I would agree with you, but no one can.

1818 Mr. Ashton: There is a witness right here who can say that he wrote this.

The Court: But he has not testified.

Mr. Ashton: I propose to call him if your Honor does not exclude it on broad grounds.

The Court: I don't think it is connected yet.

Mr. Ashton: Mr. Neave reminds me that possibly your Honor does not recall that the reason we want it particularly is that it shows the differences between the original and the one that was actually sent. You recall that matter?

1819

The Court: There is a difference between J and K.

Mr. Ashton: Yes, a difference and between this 29 and the other two also.

The Court: I realize that. I looked at 29 although it is not in evidence and I do not think I would be justified in basing any finding on it.

Mr. Ashton: Yes, your Honor.

1820

JOHN L. SCHERMERHORN, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is John L. Schermerhorn, I reside 41 South Munn Avenue, East Orange, N. J. I am vice-president of the American Transformer Company. I have been connected with the company since July, 1929. 1821

By the Court:

I was vice-president in July of 1929.

By Mr. Ashton:

The handwriting in the upper left-hand corner of this letter, Plaintiffs' Exhibit 29 for identification, is mine. I placed it there possibly a year and a half ago, I don't know definitely. I

removed the letter from the files of the American Transformer Company.

By the Court:

I do not know who put it in the files. I did see it before a year and a half ago. I saw it in July, 1929. It was shown to me by Mr. Loughead. I believe so. Mr. Hunter of our company was also present.

1823 By Mr. Ashton:

I do not know where the letter originated. I believe it was not prepared by my company because our company never used letter paper like that.

Mr. Ashton: I now offer the letter of July 3, 1929, in evidence.

Mr. Darby: I object to its receipt in evidence.

The Court: Sustained.

Mr. Ashton: Exception.

1824 Mr. Darby: No cross examination.

Mr. Ashton: I understand that there is no objection to the letters, as far as the proof is concerned, on these matters of correspondence between Radio Corporation and American Transformer Company, is that correct, Mr. Darby?

Mr. Darby: That is correct, providing they are the letters that we have discussed and examined prior to the trial.

Mr. Ashton: Here are two letters that you have not examined and there are two more here.

1825

Mr. Darby: I do not put you to the proof as to these letters, but I object to them as irrelevant and immaterial.

Mr. Ashton: They show that the American Transformer Company was fully notified as early as September 13th.

Mr. Darby: Will you let the Court read them to see what they show?

Mr. Ashton: I am just telling you because I thought it could shorten it.

(Document handed to the Court.) 1826

The Court: I will allow it.

Mr. Berliner: May I add an objection based on this ground: What the Radio Corporation of America in an exchange of correspondence with the American Transformer Company in September of 1927 did, does not bind this defendant, and certainly it does not bind the respective transactions that these parties had between themselves.

The Court: I agree with you entirely.

Mr. Berliner: Exception. 1827

Mr. Ashton: I would like to suggest that all these letters relating to the refund of royalties, and so forth, be marked as one exhibit.

I will ask that the letter of September 13, 1927, from American Transformer Company to the Radio Corporation of America; and the letter of September 16, 1927, from Radio Corporation to American Transformer Company be marked as one exhibit, Plaintiffs' Exhibit 76.

(Marked Plaintiffs' Exhibit No. 76.)

Mr. Ashton: As to this correspondence

between Radio Corporation and American Transformer Company, Mr. Anderson will testify that he communicated with these people before the letter was sent. I will put him on for that purpose.

EWEN C. ANDERSON, called as a witness on behalf of the plaintiffs, in rebuttal, having been duly sworn, testified as follows:

Direct Examination by Mr. Ashton:

My name is Ewen C. Anderson. I am license administrator of the Radio Corporation of America. I communicated with the American Transformer Company in November, 1929, with respect to its license.

The Court: That is two months after this suit was brought.

Mr. Ashton: That is true.

By Mr. Ashton:

I communicated with American Transformer Company prior to November, 1929; in the late summer of 1929. I called Mr. Schermerhorn, vice-president of the company on the telephone and told him that I had some matters that I wanted to discuss with him regarding his operations. Mr. Schermerhorn then called on me at my office and I advised him he was selling apparatus to which he was not licensed, and I

pointed out also to him several advertisements that his company had used in advertising apparatus outside the scope of his license. I notified the other licensees who had similar licenses.

Q. Did you do it by letter such as the letter of November, 1929?

Mr. Darby: I object to what he did with others as incompetent, irrelevant and immaterial. 1832

The Court: I will sustain the objection.

Mr. Darby: No cross examination.

Mr. Ashton: I offer the letter of November 14, 1929, with Mr. Anderson's memorandum to Mr. Schairer, his superior of that date, stating that he had communicated with the American Transformer people.

The Court: I don't think this letter adds anything to his testimony.

Mr. Ashton: I now offer in evidence as one exhibit the following letters. Mr. 1833 Darby, can we agree that we can read these letters into the record without holding the Court here?

Mr. Darby: Are those the letters that we have gone over and agreed on?

Mr. Ashton: You have seen them all. They are exactly the ones you have seen.

I offer in evidence as one exhibit the following papers:

1. Letter from Radio Corporation to American Transformer Company of December 18th, 1930, and attached schedules A and B;

2. Letter of American Transformer Company to Radio Corporation, dated January 5, 1931;

3. Letter of Radio Corporation to American Transformer Company of April 17, 1931;

4. Letter of Arthur Young & Company to Radio Corporation of America of May 15, 1931;

1835 5. Letter of Radio Corporation of America to American Transformer Company of June 10th, 1931, and attached schedule;

6. Letter of Radio Corporation to American Transformer Company of June 22, 1931;

7. Letter of Radio Corporation to American Transformer Company of December 30, 1931, and attached schedules A, B, C and D;

8. Letter of Radio Corporation to American Transformer Company of January 7, 1932;

1836 9. Check of Radio Corporation of America to American Transformer Company, dated December 9, 1930, both face and back, the check showing endorsements;

10. Check of Radio Corporation of America to American Transformer Company of June 4, 1931, both face and back, showing endorsements.

Mr. Berliner: We object to the admission of this evidence, on the ground it is incompetent, irrelevant and immaterial, not binding upon the defendant, being transactions with respect to alleged refunds of royalties between the American

Transformer Company and the R. C. A.

The Court: Objection overruled.

Mr. Berliner: Exception.

(Marked Plaintiffs' Exhibit No. 77.)

Mr. Ashton: I offer in evidence the file history of Arnold application Serial Number 841,567, filed May 28, 1914.

(Marked Plaintiffs' Exhibit No. 78.)

1838

SUR-REBUTTAL PROOFS.

EMANUEL M. ZELONY, recalled as a witness on behalf of the defendant, in sur-rebuttal, having been previously sworn, testified further as follows:

Direct Examination by Mr. Darby:

I was in the courtroom when Mr. Otterson testified. He is the gentleman I saw when I had the conversation that I previously testified about. 1839

JOHN L. SCHERMERHORN, called as a witness on behalf of the defendant, in sur-rebuttal, having been previously sworn, testified as follows:

Direct Examination by Mr. Darby:

I heard the testimony of Mr. Anderson. I had a conversation with Mr. Anderson of the substance that he testified about. That occurred in October or November, 1929.

1840 *Stipulation and Order Approving Narrative Statement of the Evidence.*

Mr. Darby: Upon the strength of Mr. Schermerhorn's testimony I move to strike out the testimony of Mr. Anderson.

The Court: They may both stand.

Mr. Darby: Exception.

(Defendant rests. Case closed.)

1841

Stipulation and Order Approving Narrative Statement of the Evidence.

The foregoing narrative statement of the testimony, taken at the trial, having been presented to me, the same is hereby approved and allowed, and is ordered filed as a statement of the evidence to be included in the record on appeal, as provided by Equity Rule 75.

1842 Dated, March , 1937.

MORTIMER W. BYERS,
U. S. District Judge.

Consented to.

HENRY R. ASHTON,
Solicitor for Plaintiffs.

SAMUEL E. DARBY, JR.,
Solicitor for Defendant.

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Vol. II

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, [redacted] 1938

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
PETITIONER,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT

PETITION FOR CERTIORARI FILED AUGUST 31, 1937.

CERTIORARI GRANTED OCTOBER 11, 1937.

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879,532	DeForest	Feb. 18, 1908	1428
884,110	Stone, *et al.*	Apr. 7, 1908	1432
995,126	DeForest	June 13, 1911	1435
1,012,456	Seibt	Dec. 19, 1911	1438
1,038,910	Von Lieben, *et al.*	Sept. 17, 1912	1441
1,114,845	Arnold	Oct. 27, 1914	1446
1,127,371	Pierce	Feb. 2, 1915	1448
1,129,942	Arnold	Mar. 2, 1915	1453
1,129,943	Arnold	Mar. 2, 1915	1459
1,129,959	Colpitts	Mar. 2, 1915	1463
1,137,384	Colpitts	Apr. 27, 1915	1468
1,227,113	Campbell	May 22, 1917	1472
1,234,489	Reisz	July 24, 1917	1483
Re 14,380	Colpitts	Oct. 23, 1917	1486
1,257,361	Nichols	Feb. 26, 1918	1491
1,330,471	Kendall	Feb. 10, 1920	1497

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1,350,752	Van der Bijl	Aug. 24, 1920		1507
1,375,447	DeForest	Apr. 19, 1921		1514
1,377,405	DeForest	May 10, 1921		1523
1,384,108	Weagant	July 12, 1921		1528
1,388,450	Colpitts, *et al.*	Aug. 23, 1921		1531
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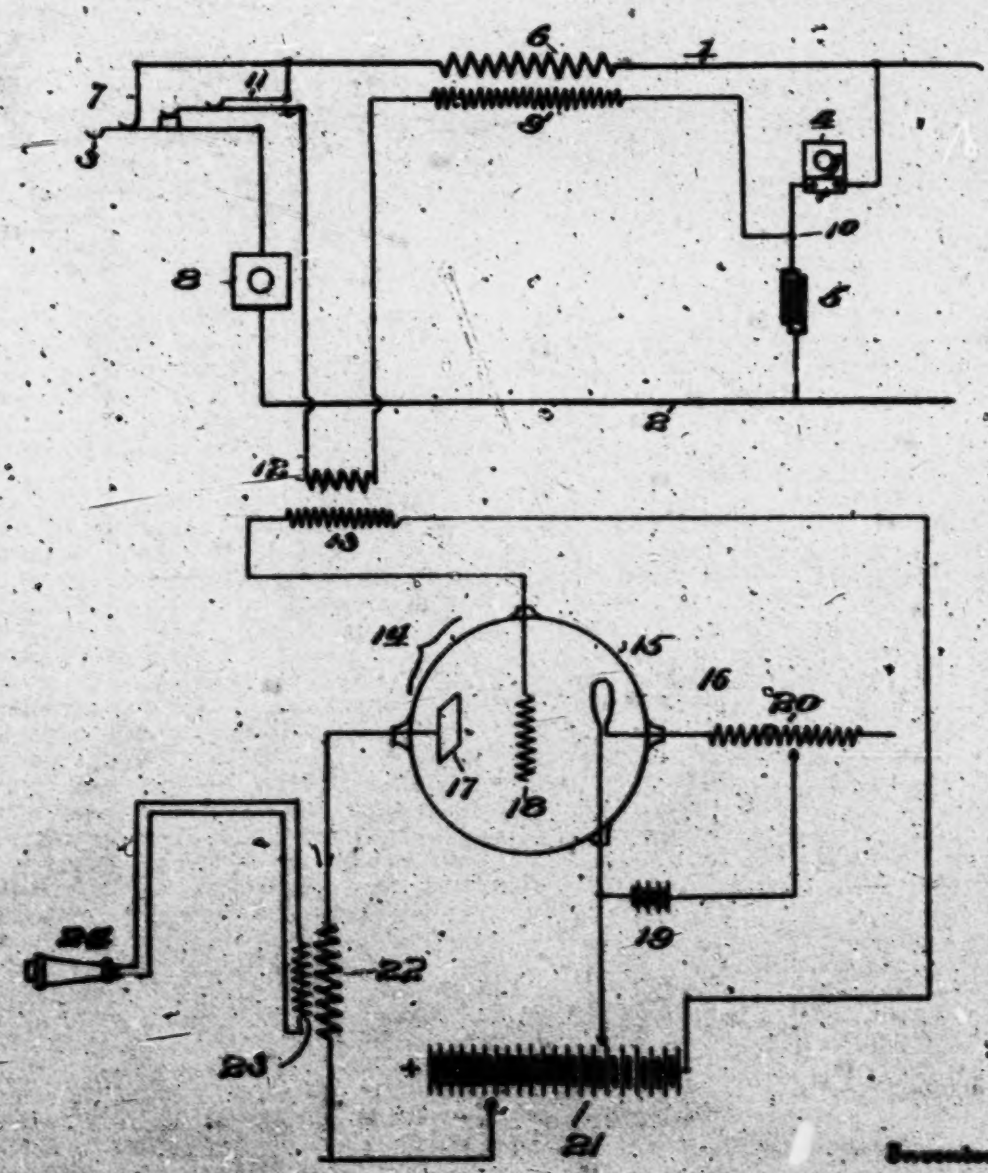
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F. LOWENSTEIN.

TELEPHONE RELAY.

APPLICATION FILED APR. 24, 1912. RENEWED APR. 26, 1917.

1,231,764. Patented July 3, 1917.



Witnesses

Inventor

By Lowenstein

By his Attorney

UNITED STATES PATENT OFFICE.

FRITZ LOWENSTEIN, OF NEW YORK, N. Y.

TELEPHONE-RELAY.

1,231,764. Specification of Letters Patent. Patented July 3, 1917.

Application filed April 24, 1912, Serial No. 693,886. Renewed April 22, 1917. Serial No. 163,787.

To all whom it may concern:

Be it known that I, FRITZ LOWENSTEIN, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Telephone-Relays, of which the following is a specification.

My invention relates to improvements in telephone relays.

The object of my invention is to provide a relay by means of which the relation of the potential differences of the complex incoming speech currents is well maintained in the telephone receiver, so that the sound reproduced by the receiver diaphragm will be composed of waves of practically the same frequencies as impinge upon the transmitter diaphragm, and, what I consider most important, these various frequencies will have about the same relative amplitudes as in the original sound waves actuating the transmitter. As a result of this the reproduced sound is intelligible.

It is frequently the case with long distance telephoning that under certain conditions the sound of a speaker's voice may be heard very plainly in the receiver, while at the same time it is unintelligible. As a result of experiments I have ascertained that this lack of intelligibility is due principally to the fact that the speech currents of higher frequencies are attenuated to a greater relative extent than are the speech currents of low frequency due to electrical properties of a long line, so that the incoming speech current is distorted. Furthermore, this distortion is but little affected by terminal conditions, and hence relays or receiving apparatus functioning according to current values cannot remedy the distortion or compensate for the effects thereon.

On the other hand the terminal voltages are materially affected by terminal conditions, and hence it is possible to select such terminal conditions as will enable the relative amplitudes of the original voltages to be well maintained at the incoming end of the line. Therefore, a relay apparatus which functions according to terminal voltages is well adapted for the production of receiver operating currents of the desired absolute strengths and in the relative strengths necessary for the successful operation of the telephone receiver.

My invention will now be explained in connection with one embodiment thereof.

The drawing is a diagrammatic view of so much of one well known form of telephone system as is necessary to explain the construction and operation of my improved relay.

Referring first to the old elements of the system, it will be seen that two wires only, 1 and 2, are used for the three purposes of ringing, microphone operation and transmitting the talking current. When the station is not in use and the receiver is on hook 3 the line 1—2 is connected only through the bridge containing a bell 4 of high self-inductance and a condenser 5 proportioned so as to be in resonance with the self-inductance 4 on 16 cycles, which frequency is used for ringing current.

When the receiver is removed from the hook 3, the line 1—2 is closed also by way of primary 6 of the telephone induction coil, switch contact 7 and microphone 8. On the same core with primary 6 of the induction coil is secondary 9, one terminal of which is connected on the junction point 10 between the bell and condenser of the ringing circuit and the other terminal of which connects through the telephone receiver and contact switch 11 to one side of the primary 6 of the induction coil.

In applying my instrument I substitute for the usual telephone receiver the primary 12 of a step-up transformer which produces in its secondary 13 comparatively high potential. At 14 is an ion or an electron controller, or audion, consisting of a container 15 evacuated and provided with an incandescent filament 16, an anode 17 and a modulating or controlling member 18, which in the present example is a mere grid. Incandescent filament 16 is fed by battery 19 through an adjustable rheostat 20 which permits fine adjustments of the incandescence of the filament. A battery 21 is provided which furnishes current through the evacuated field, the positive pole of the battery being connected to anode 17, a negative point of the battery being connected to filament 16. The potentials created in secondary 13 are made to control the current flowing through the ion field and originating in battery 21 by connecting the one terminal of coil 13 to the modulating member 18 and the other terminal of said coil to a point on the battery 21, which is

located ultranegatively relative to the negative point of the battery connected to the filament. This ultranegative connection is especially desirable and constitutes an important feature of my invention in its preferred embodiment. The volume and clearness of speech as heard in the receiver in the arrangement shown is materially greater than where the grid 18 and coil 23 are connected, for example, to a point at the same potential as the filament 16. The theoretical considerations involved are somewhat abstruse and not fully understood; but the advantage of the ultranegative connection is fully established by repeated tests which I have carried out in actual practice. I therefore note the fact without attempting to explain it. Both the positive and the ultranegative points of connection to battery 21 are adjustable to enable variation of the driving potential of battery 21 for the ionic field and of the ultranegative potential. A telephone of many convolutions, may be inserted at 22; but to enable the use of the usual commercial telephone where desired, 23 should be a high winding of an induction coil transforming the energy from small current and high potential in coil 23 into a current of lower potential but higher amperage so as to make this energy more available for the commercial telephone receiver 24.

The operation of the ionic controller is as follows:

The incandescent filament 16 produces ionization of the gas contained in container 15 and thereby makes the gas a conductor. The potential between filament 16 and anode 17 derived from battery 21 creates a static field between such filament and anode which exerts a driving power on the ionized gas particles which come in contact with incandescent filament 16 and which are thereby electrically charged. A negative charge in an electric field is acted upon by a force in the direction of the field lines from negative to positive point of the field and the amount of negative current which is therefore conveyed through the field is dependent on the ionization power of the filament, the quantity of the individual charge and the strength of the electric field.

The ionization power of the filament is a function of its temperature and therefore of its incandescence. The individual charge is a function of the negative potential of the filament and also of the degree of evacuation. The intensity of the field is a function of the potential difference between filament and anode and of their distance, which also dependencies may therefore be expressed as the potential gradient of the field. Therefore the current in the ionic field circuit will increase with the incandescence of the filament, the potential difference of the battery and, up to a certain point, with the evacuation.

By providing a modifying or controlling device, such for example as the modulating means 18, which is subjected to an impressed potential more negative than that of the cathode and which is adapted and arranged to interpose between the anode and cathode a modifying or controlling field of the desired character, the potential gradient between the filament and the controlling device or modulating means may be changed and thereby the current which flows through the ionic circuit changed accordingly. By applying variable potentials to the modulating means 18 the currents in the ionic field circuit are varied accordingly and as the impressing of a potential on conductor 18 need not be accompanied by an appreciable expenditure of energy, whereas the energy of the ionic field circuit is varying considerably, I have a means to produce great changes of energy in that field circuit by variation of potentials which do not require appreciable energy.

Having thus fully described my invention, what I claim is:

1. Telephone apparatus comprising the combination, with a talking circuit, of a suitably energized relay circuit including an anode and a cathode separated by a conductive gap, a modulating device interposed in said gap and electrically connected with said talking circuit, means for impressing upon said modulating device a potential more negative than that of said cathode, and a translating device arranged to be energized from said relay circuit.

2. Telephone receiving apparatus, comprising the combination with a talking circuit, of an ion controller having an anode and a cathode connected in a second circuit electrically related to said talking circuit, a modulating device interposed between said anode and cathode, means for energizing said modulating device from said talking circuit and also from a source of potential which is negative with respect to said cathode, and a telephone receiver arranged to be energized from the controller circuit.

3. Telephone receiving apparatus comprising the combination, with a talking circuit, of an ionic controller having an anode and a cathode suitably spaced apart, a battery, connections from said anode and cathode to the battery, a grid electrically connected to said talking circuit and interposed between said anode and cathode, a connection from said grid to said battery, the battery connection of the grid being negative with respect to the battery connection of the cathode, and a telephone receiver arranged to be energized from the controller circuit.

4. Telephone apparatus comprising the

combination, with a talking circuit, of a cooperating circuit suitably energized and including an anode and a cathode separated by a conductive gap, a modifying or controlling device interposed between said anode and cathode and subjected to an impressed potential more negative than that of said cathode, and a third circuit energized by said cooperating circuit.

5. The combination, with an exhausted container, and an anode and a cathode located therein and included in a suitably energized circuit, of a modifying or controlling device interposed between said anode and cathode and connected to a source of potential more negative than said cathode, and another circuit inductively related to the first mentioned circuit.

6. The combination, with an exhausted container, and an anode and a cathode located therein and included in a suitably energized circuit, of a modifying or controlling device connected to a source of potential more negative than said cathode and adapted and arranged to influence the character of the field between said anode and cathode, and another circuit inductively related to the first mentioned circuit.

7. The combination, with an audion having its anode and cathode included in a suitably energized circuit, of means for impressing upon the audion grid a potential more negative than that of the audion cathode.

In witness whereof I have hereunto affixed my hand this tenth day of January, 1912.

FRITZ LOWENSTEIN.

Witnesses:
O. F. Rothen,
L. Baschang.

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PAGE

PLAINTIFF'S EXHIBIT No. 1 B 619

R. C. MATHES.
CIRCUITS FOR ELECTRON DISCHARGE DEVICES.
APPLICATION FILED OCT. 23, 1916.

1,426,754. Patented Aug. 22, 1922.
2 SHEETS—SHEET 1.

Fig. 1.

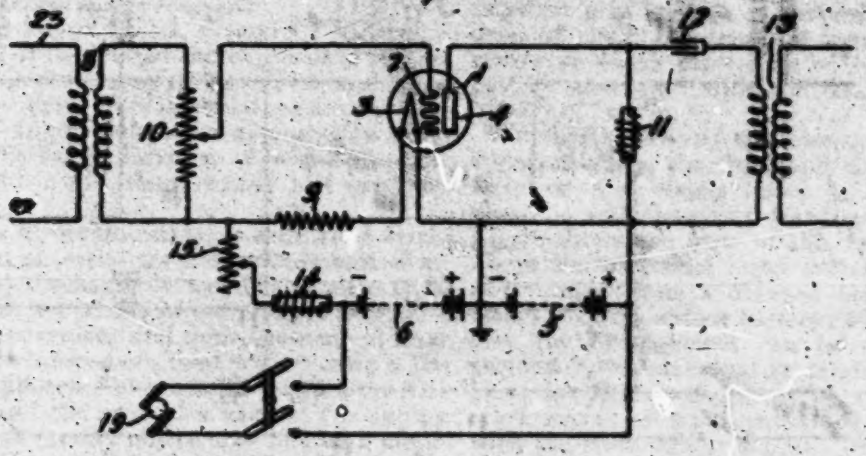
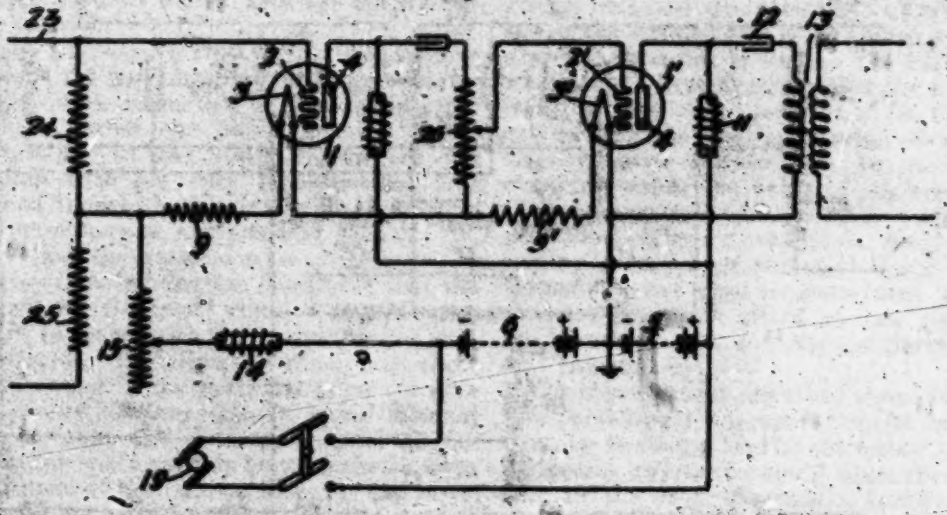


Fig. 2.



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CIRCUITS FOR ELECTRON DISCHARGE DEVICES.

APPLICATION FILED OCT. 23, 1916.

1,426,754. Patented Aug. 22, 1922.

2 SHEETS—SHEET 2.

Fig. 3.

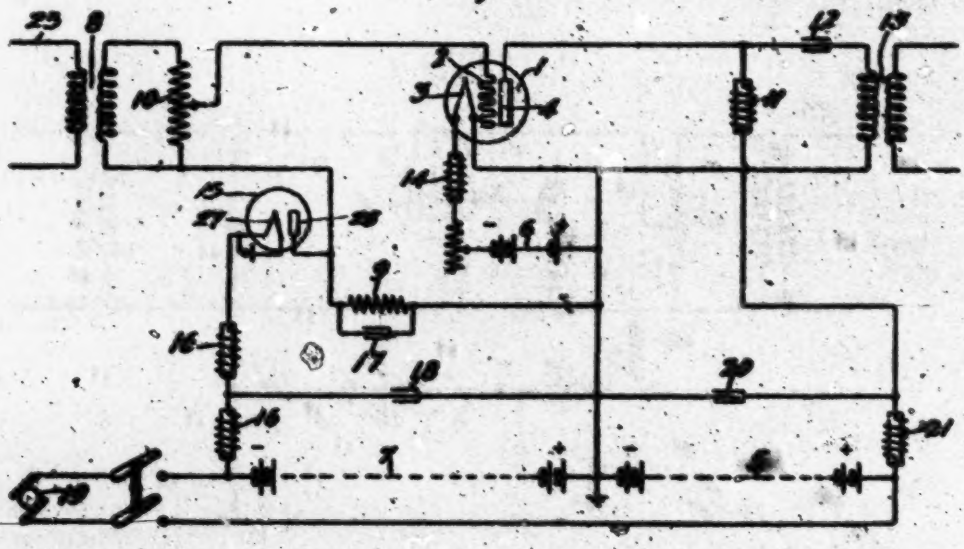
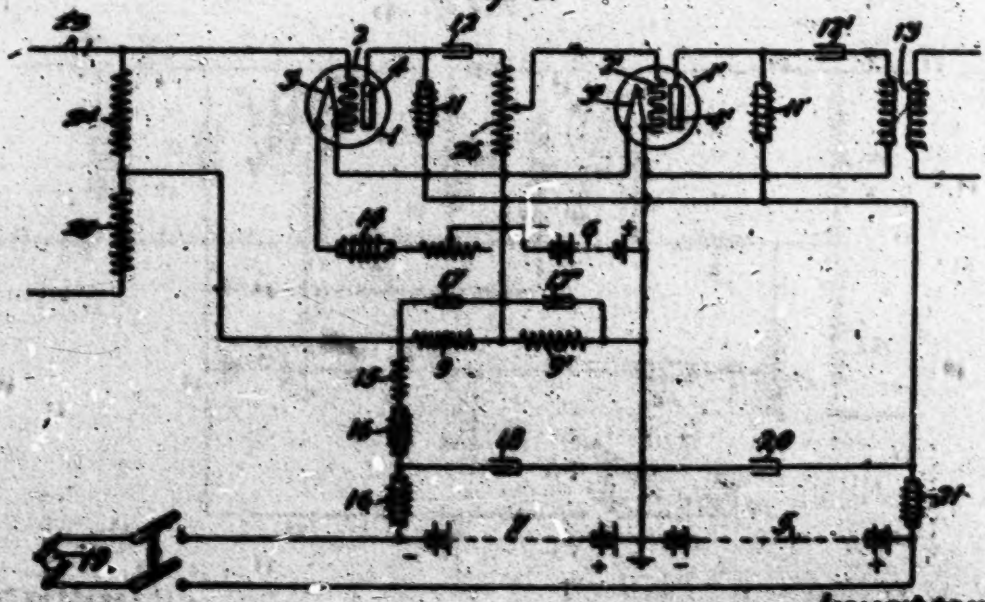


Fig. 4.



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UNITED STATES PATENT OFFICE.

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CIRCUITS FOR ELECTRON-DISCHARGE DEVICES.

1,426,754. Specification of Letters Patent. Patented Aug. 22, 1922.

Application filed October 20, 1916. Serial No. 126,654.

To all whom it may concern:

Be it known that I, ROBERT C. MATHES, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Circuits for Electron-Discharge Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to sources of direct current potential for the input circuit of an electron discharge device of the audion type.

An object of the invention is to provide a more convenient and desirable method than has heretofore been used for securing a desired difference of potential between the filament and the grid of a tube of the audion type. A further object is to furnish a method and means for compensating for fluctuations in the potential of the output circuit battery of the vacuum tube.

Specifically, these objects may be realized by the indirect use of the heating battery or of some other source, but in either case associating said source with the output circuit battery.

It is well-known that the current flowing through the output circuit undergoes fluctuations owing to sudden or gradual internal changes within the power battery. Such fluctuations in the space current of the vacuum tube are very troublesome. The method by which this invention overcomes this error may be explained as follows: Assume that the vacuum tube circuits are so arranged, as hereinafter described, that the current for the input circuit comes from a source in series with the source for the output circuit. For illustration, suppose there is a decrease in the potential from the output circuit battery due to some internal change; this will necessarily tend to decrease the space current between the filament and anode of the vacuum tube. If the input and output batteries are of similar nature, this change will in all probability also decrease the potential of the input circuit battery, which is in series with it, so that the grid potential will become less negative thereby tending to increase the space current to its former value. The compensation would take place in a similar manner for an increase in the voltage of the batteries, due, for instance, to the batteries being charged by some suitable means.

This scheme works especially well if the negative grid voltage is derived from the drop of potential across the terminals of a resistance which derives its current from a battery associated with the output circuit battery.

Further objects of the invention will be apparent from the following detailed description and claims taken in connection with the accompanying drawings in which Fig. 1 shows one form of this invention in which the source of input voltage is indirectly taken from a filament battery associated with the output battery; Fig. 2 shows how the arrangement can be applied to vacuum tubes connected in tandem; Fig. 3 gives another arrangement in which some other source of input voltage is associated with the plate circuit supply; Fig. 4 is the arrangement of Fig. 3 applied to two vacuum tubes in tandem. A similar notation is used in all the figures.

In Fig. 1, 1 is a vacuum tube of the audion type containing a grid 2, a filament 3, and an anode 4. The negative voltage for the grid is obtained from the drop of potential across the terminals of a resistance 9. This drop of potential is due to the battery 6, which is the heating source for the filament 3 and is equal to the product of the filament current and the resistance value of 9. The negative grid voltage may be varied by changing either the value of the resistance 13 or resistance 9. 19 is a battery charging generator. The output circuit, besides containing a source of potential 5 and transformer 12, has also an inductance 11, and capacity 12, which afford an easy path for the direct current and the oscillating current respectively.

The arrangement described above is therefore particularly adapted to repeat impulses from an incoming line 22 since they may be impressed by transformer 8 upon the resistance 10, the drop of potential across a portion of which is impressed upon the grid 2. The amplified oscillations in the output circuit by transformer 18 may be impressed upon any suitable outgoing line. A choke coil 14 is shown inserted in series with the battery 6 to prevent any variations in its potential from being impressed on the tube 1.

By the variation of the character of resistance 9, more exact compensation can be obtained for the change in the space current of tube 1. If the system given under-com-

pensation, the resistance should be constituted of iron wire or some other suitable material having a high positive temperature co-efficient so that its resistance increases with increase of current. However, if the system gives over-compensation, the resistance may be the impedance of a vacuum tube, an impedance which decreases with increase in current. If considered more convenient, resistance 15 or any part thereof may be made with these variable characteristics, in which case the preceding two sentences apply with the terms of "under-compensation" and "over-compensation" interchanged. It is to be understood, however, that practically good results are obtained by the use of resistances 9 and 15 of ordinary character.

In Fig. 2 we have the scheme of Figure 1 used for two vacuum tubes connected in tandem in a manner now well understood in the art. The negative voltage for grid 2 is due to a drop of potential across the terminals of the resistance 9, while for grid 2' it is due to the drop across the terminals of resistance 9', both resistances being included in the heating circuit of the two filaments which are here arranged in series but may be connected in parallel if desired. Connected across the line 23, are two resistances 24 and 25, only one of which may be associated with the input circuit of the tube 1, if it is desired to impress on the tube only a portion of the total drop of potential across the line 23. The amplified oscillations in the output circuit of tube 1 are impressed by the impedance 26 upon tube 1' which is connected to an outgoing line by transformer 13.

In Fig. 3 the negative grid voltage is supplied from the drop of potential across the terminals of the resistance 9, this drop of potential being due to a source of voltage 7 associated with the battery 5 of the output circuit. In order to keep the grid circuit free from the effects of short, sudden fluctuations arising from the battery 7, it will be desirable, in general, to have a condenser 18 shunted across it and inductance 16, 16 inserted in series with the battery. The effects of similar fluctuations in 5 may be avoided or diminished by a condenser 20 and inductance 21. Condenser 17 may be shunted across 9 to serve as an easy path for the oscillations in the input circuit; and particularly it may be used to minimize cross-talk in case more than one amplifier of this type is operated from a common battery. Resistance 15 is shown in Fig. 3 in the form of a vacuum tube having a heated filament 27, and an anode 28. This form of impedance for obtaining the desired voltage for the input circuit is preferable in case the arrangement is such that the use of ordinary resistances would give under-compensation, since as is well known, the impedance of a vacuum tube decreases with increase in current passing therethrough. A similar result may be obtained, as noted above, by employing an ordinary resistance 15 and an iron wire resistance 9, since the iron wire will increase in resistance with increase in current and being in shunt with the grid circuit will take care of any tendency to under-compensation.

In Fig. 4 the same method as in Fig. 3 is illustrated for two vacuum tubes in tandem. The two filaments 3 and 3' are shown connected in series with a heating source 6. The two resistances 9 and 9' are also connected in series, their common source of current being the battery 7. The various condensers and inductances are inserted for reasons previously given. All the resistances shown in these drawings may be of the variable type.

The system may assume still other forms than those herein described without departing in anywise from the spirit of this invention.

It will be noted that the batteries 5 and 6 of Figs. 1 and 2, or the batteries 7 and 5 of Figs. 3 and 4, are of the same type and will therefore be subjected to the same sort of fluctuations. If, for example, these batteries are dry cells, they will gradually drop in voltage as they are used and, as explained heretofore, a gradual drop in the voltage of the output battery will be compensated for by a similar drop in the input battery. If these batteries are storage batteries, there will be a gradual drop in voltage of both input and output batteries during discharge. On closing the switch 19 for charging, there will be a sudden increase in voltage in both batteries followed by a gradual increase during the charging period. In any event any changes common to both batteries tend to compensate each other's effect.

What is claimed is:

1. In an electric translating circuit, an electron discharge device having a heated filament, an anode and a grid, said grid and filament being in the input circuit, a battery for the output circuit, means for bringing the grid to a different potential than the filament, comprising a resistance in the input circuit and a battery for supplying current therefor, the grid-filament steady potential difference being determined substantially solely by the drop in said resistance said means so arranged that gradual fluctuations in the strength of the output battery will be compensated for by fluctuations in the input battery.

2. In an electric translating circuit, an electron discharge device having a heated filament, an anode and a grid, said grid and filament being in the input circuit, a battery for the output circuit, means for bringing the grid to a lower potential than the

filament, comprising a resistance in the input circuit and a battery for supplying current therefor, the grid-filament steady potential difference being determined substantially solely by the drop in said resistance, said means so arranged that the effects of fluctuations in the voltage of the output circuit battery will be minimized by fluctuations in the input circuit battery.

3. In an electric translating circuit, an electron discharge device having a filament, an anode and a grid, said filament and grid being in the input circuit, a resistance in said input circuit, an output battery and an input battery in series, said input battery supplying current to the resistance in the input circuit, the grid-filament steady potential difference being determined substantially solely by the drop in said resistance, said batteries being of such a type as to be subject to the same gradual fluctuations whereby the space current will be substantially independent of said fluctuations and means in series with said batteries for simultaneously charging the same.

4. In an electric translating circuit, an electron discharge device having a filament, an anode and a grid, said filament and grid being in the input circuit, a resistance in said input circuit, an output battery and an input battery in series, said input battery serving as the heating source for the filament and also supplying current to the resistance in the input circuit, the grid-filament steady potential difference being determined substantially solely by the drop in said resistance, said batteries being of such a type as to be subject to the same gradual fluctuations whereby the space current will be substantially independent of said fluctuations and means in series with said batteries for simultaneously charging the same.

5. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, means for normally maintaining said auxiliary electrode at a lower potential than any part of said cathode, said means comprising a resistance shunted by a circuit containing a source of steady voltage, the normal potential difference between the auxiliary electrode and said cathode being determined principally by the drop in said resistance, and a separate source of space current between said cathode and said anode.

6. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, said auxiliary electrode and cathode being in the input circuit of said tube; means for normally maintaining said auxiliary electrode at a lower potential than any part of said cathode, said means comprising a resistance in said input circuit, said resistance being shunted by a source of steady voltage, the normal potential difference between said auxiliary electrode and said cathode being determined principally by the drop in said resistance, and a separate source of space current between said cathode and said anode.

7. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, and resistance means for simultaneously heating said cathode and for bringing said auxiliary electrode at a lower potential than any part of [illegible] normal potential difference between said auxiliary electrode and said cathode being determined principally by the drop in said resistance means.

8. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, said auxiliary electrode and said cathode being in the input circuit of said tube, a source of current connected to said cathode, a resistance, a circuit containing said cathode, said source and said resistance in series, said resistance being also included in the input circuit of said tube in such a manner that the potential of said auxiliary electrode is normally maintained lower than any part of said cathode by an amount substantially equal to the drop in said resistance, said cathode being rendered thermionically active by current flowing in said series circuit.

9. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, said auxiliary electrode and said cathode being in the input circuit of said tube, a source of current connected to said cathode, a resistance connected in series with said source and said cathode, said resistance being also included in the input circuit of said tube, said cathode being rendered thermionically active by current flowing in said series circuit, the normal potential difference between the auxiliary electrode and said cathode being determined principally by the drop in said resistance.

10. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, a resistance, a source of steady voltage for said resistance, and means for impressing the drop of potential across said resistance between said auxiliary electrode and said cathode, whereby the potential of said auxiliary electrode is normally maintained lower than any part of said cathode by an amount substantially equal to the drop in said resistance, and a separate source of space current between said anode and said cathode.

11. The combination with a thermionic device, of an iron wire, a source of current for said wire, and means for supplying the

drop of potential across said wire to said device.

12. The combination with a thermionic device having an input circuit, of an iron wire, a source of current for said wire, and means for impressing the drop of potential across said wire upon the input circuit of said device.

13. In combination a vacuum tube having cathode, anode and control electrodes, a source of space current therefor, a second source of current, a path containing resistance traversed by current from said second source, and permanent connections from spaced points on said path to said cathode and control electrodes respectively, the minimum normal potential difference between said control electrode and said cathode being maintained substantially equal to the drop in said resistance between said spaced points.

14. In combination a vacuum tube having cathode, anode and control electrodes, a source of space current therefor, a second source of current, a resistance traversed by current from said second source, and permanent connections from the positive and negative ends of said resistance to said cathode and control electrodes respectively, the potential of said control electrode being normally maintained more negative than the negative end of said cathode by an amount substantially equal to the drop in said resistance.

15. The method of controlling the operation of a vacuum tube circuit the input of which is impressed on a grid and in which the potential of the source of space current is subject to variations, which comprises automatically varying the potential of said grid in such a manner as to compensate for said variations.

16. The method of controlling the operation of a vacuum tube circuit the input of which is impressed on a grid and in which the potential of the source of space current is subject to variations, which comprises automatically making the potential of said grid more negative as said source of space current increases in potential.

17. The method of operating a vacuum tube translating device, the operation of which depends on the voltage of a source of current which is variable, which comprises varying the operation of said translating device in a manner complementary to the change in operation due to a fluctuation of said voltage.

18. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and a grid, and a normally unipotential connection from the grid of one of said tubes to the cathode of another tube.

19. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and grid, and a normally unipotential connection from the grid of one of said tubes to the cathode of a preceding tube.

20. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and grid, and a normally unipotential connection from the grid of one of said tubes to the cathode of the tube next preceding.

21. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having a cathode and a grid, and a normally unipotential connection from one grid in the series to the cathode of the first tube of the series.

22. A vacuum tube apparatus comprising a plurality of tubes arranged in a series and each having electrodes, and means for maintaining the potential of an electrode in one of said tubes at a predetermined potential with reference to another electrode of said tube, said means comprising a normally unipotential connection between said electrode and an electrode in a preceding tube of the series.

23. In a multi-stage vacuum tube amplifier in which the anode of one tube is connected conductively to one terminal of a condenser, the other terminal of which is conductively connected to the auxiliary electrode of the next succeeding tube, a connection from said auxiliary electrode to the cathode heating circuit of said succeeding tube, and an impedance in said heating circuit, said auxiliary electrode deriving its steady potential substantially solely from the drop in said impedance.

24. In a multi-stage vacuum tube amplifier, a coupling between two tubes comprising a condenser connected to the anode of one tube and to the auxiliary electrode of the other tube, an impedance between the anode side of the condenser and the space current battery, an impedance between the auxiliary electrode side of the condenser and the filament heating battery, and an impedance between the negative end of the filament of the second tube and said last mentioned impedance.

25. In a vacuum tube amplifier circuit wherein the space current of said amplifier depends upon the voltage of a variable source of current connected to an anode and a cathode, the method which comprises supplying said circuit with at least two impulses, one a compensated impulse derived from an effect produced by variations of said source and the other due to an impulse to be amplified.

26. In a vacuum tube amplifier circuit wherein the space current of said amplifier depends upon the voltage of a variable source of current, the method which com-

prises supplying said circuit with impulses to be amplified and by-passing a portion of the impulses caused by variations in said source of current to a point in the circuit whereby said last mentioned impulses are rendered self-compensatory.

27. A vacuum tube translating device having a cathode and an anode, a source of space current connected to said cathode and anode, and means responsive to an effect produced by said source of current for changing the impedance of the space between said cathode and said anode in a manner to compensate for changes in said source.

In witness whereof, I hereunto subscribe my name this 9 day of October A. D., 1916.

ROBERT C. MATHES.

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626

PLAINTIFF S' EXHIBIT No. 1 C

H. DE F. ARNOLD.
THERMIONIC AMPLIFIER.
APPLICATION FILED JULY 30, 1918.

1,329,283. Patented Jan. 27, 1920.
2 SHEETS—SHEET 1.

Fig. 1.

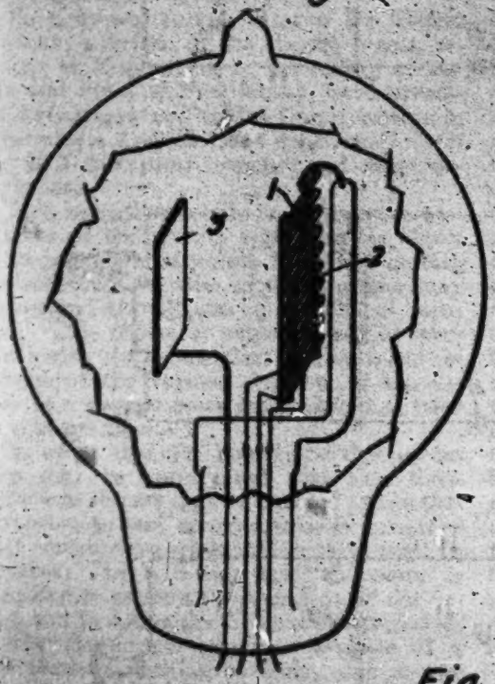


Fig. 2.





Fig. 3.

Fig. 4.

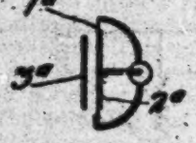


Fig. 5.

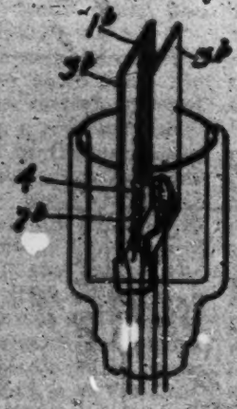


Fig. 6.



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627

H. DE F. ARNOLD.

THERMIONIC AMPLIFIER.

APPLICATION FILED JULY 30, 1918.

1,329,283. Patented Jan. 27, 1920.

2 SHEETS—SHEET 2.

Fig. 7.

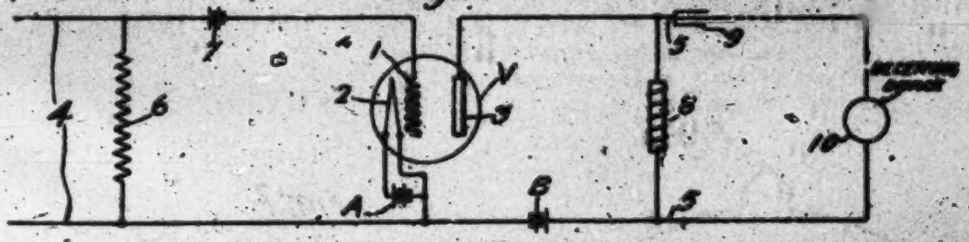


Fig. 8.

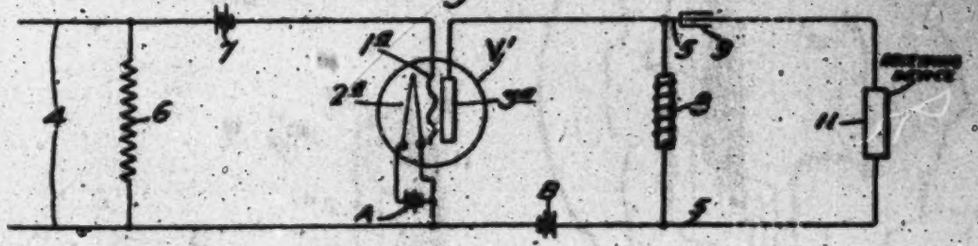


Fig. 9.



Fig. 10.



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THERMIONIC AMPLIFIER.

1,082,933. Specification of Letters Patent. Patented Jan. 27, 1914.

Caption, this is part of application Serial No. 241,827, filed May 28, 1918, and application Serial No. 241,828, filed May 28, 1918, patented March 2, 1920. This application filed July 25, 1913. Serial No. 781,422.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at Maplewood, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Thermionic Amplifiers, of which the following is a full, clear, concise, and exact description.

This invention relates to thermionic amplifiers of the audion type, and its object is to provide a structure by which certain desired characteristics of the amplifier may be secured at will and in an efficient manner. This object is accomplished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in this specification.

In order that the novelty of this invention may be appreciated, and that those skilled in the art may be enabled to use this invention to best advantage, it is necessary that certain terms hereinafter used shall be defined. The following brief discussion is intended to explain the operation of the device and to define the terms to be employed.

The thermionic amplifier consists of a hot electron-emitting cathode, such as the so-called "Wehnelt" cathode, of a cool metallic anode and of an auxiliary electrode called the grid, which is usually, though not always, located between the anode and the cathode. A battery is connected so as to force the electrons liberated at the cathode toward the anode, thus setting up a convection current carried by electrons in the evacuated space. In this specification since only the structure of the device itself is under discussion, only the effects of changes in that structure are considered. Obviously a change in the battery will also change the characteristics of the circuit, but in a way which is already known in the art. Due to the presence of these electrons, a negative space charge is established between the anode and the cathode, whose effect is to limit the number of electrons which can leave the cathode, and consequently to limit also the current which can flow in the output circuit, by which is meant the circuit including the battery and the path of the space current. The object of the grid is to furnish a means for impressing a further negative charge into the space between the anode and the cathode, or for introducing into it a positive charge which shall neutralize the effect of part of the space charge due to the electrons. In the first case, the convection current is decreased; in the second it is increased. In order to force this charge in the grid, a source of electromotive force is connected between grid and cathode, that is, between the input terminals of the device. The effect of such an impressed electromotive force is therefore to alter the magnitude of the space current in the amplifier by changing the distribution of space charge between the electrodes, and moreover this is accomplished without supposing that the impressed electromotive force shall do more work than that involved in forcing the charge into the grid against the counter voltage of the condenser formed by grid and filament. Since in this operation the change in power expended in the output circuit may be much greater than that required in charging the condenser, the device acts as an amplifier. This variation in space current, due to an impressed electromotive force, will hereafter be called the output current of the amplifier and the variation in voltage, which appears in the output circuit due to the impressed electromotive force, will be called the output voltage. The reason for choosing these definitions is that in the practical applications of the amplifier it is only these variations in current or voltage which are utilized; in fact, a transformer is ordinarily used to derive power from the output circuit, and obviously the steady space current or the steady output voltage have no effect in the secondary of that transformer and may be ignored for practical purposes. Thus, the term voltage amplification means here the ratio of the alternating voltage appearing in the secondary of such a unity ratio transformer to the alternating voltage impressed across the filament and grid, when the transformer primary is made to include the winds of the output circuit external to the amplifier. In simpler terms, it is the ratio of the above defined output voltage to the impressed input voltage.

There will also be occasion to consider the ratio of output current to input voltage, the latter being taken as standard throughout.

When this ratio is high, other things being the same, the condenser will be said to be of the high current type, and vice versa. This latter ratio is, of course, not a pure number, but is of the nature of an admittance.

It has been found that condensers may be designed for given circuit conditions so that they will have a minimum of the above mentioned characteristics, or defects. That is, one may be designed to discharge, e. g., practically during a comparatively high voltage with a low current, or vice versa. The principles of operation which have been discovered which enable this result to be accomplished may be stated, as follows.

In the first place it has been found that it is of advantage to locate the grid of one, the cathode or possibly whichever will permit voltage amplification or output control. In practice it is also found that when the two elements are separated only by a layer exhibiting exciting the most efficient action is obtained. Unless there is a solid and continuous dielectric between the two it may be necessary of course to separate them a small distance to prevent actual contact between them due to forces set up during operation. By saying that the elements are placed as close together as possible it is meant that the distance between them is such as shall not prohibit sufficient ionizing operation of mechanical disturbance during operation.

Again, it has been found that, when the cathode and grid are placed as near to each other as possible, allowing for the distance from the cathode to the nearest filament, the voltage amplifying power of the tube with all of the other factors remaining the same, is greatly increased and the current cut off is the voltage drops. This

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greater voltage amplification than those of the prior art; Fig. 2 is a plan view of the amplifier of Fig. 1 arranged to exhibit the geometrical configuration; Fig. 3 is a view of a tube structure designed to give a large output current with low or negative voltage amplification; Fig. 4 is a plan view of the structure of Fig. 3; Figs. 5 and 6 are views corresponding to Figs. 3 and 4 respectively of a modified structure of the new type of amplifier; Fig. 7 is a circuit diagram showing an amplifying system making use of an amplifier of the type shown in Fig. 1; Figs. 8, 9 and 10 are circuit diagrams showing several forms of circuit making use of an amplifier of the kind shown in Fig. 2. In these figures, like numerals represent corresponding parts.

Referring to Figs. 1 and 2, 1 represents the grid element, 2 the cathode or filament and 3 the anode or plate. The plate is placed a considerable distance from the cathode, and the grid is placed very close to the cathode and may be separated therefrom only by a thin insulating film or, for example, an oxide, coating on one or the other of these elements. Further, the grid is made to have a fine mesh and thus to obstruct greatly the view of the plate as seen from the cathode.

Figs. 3 and 4 are two views of a thermionic amplifier of the high current type. In these structures, in conformity with the above mentioned principles, the distance from plate P to cathode F is made very small, and the grid is placed as close as possible to the cathode. Further, the grid P is made to have a coarse mesh, or is constructed to have a large ratio of open space to conducting surface, as is required by the conditions always set forth for this type of amplifier.

Figs. 5 and 6 show another modification of the high current type of amplifier. The input electrode or grid is in the form of a wire P, bent back at its middle. In effect, therefore, the input electrode consists of two wires joined together. The filament F is wound about the input electrode and is insulated therefrom by a tube of insulating material 4, an arrangement which is not the invention of this applicant, but is described and claimed in Patent 1,107,622 of Jan. 26, 1915 to Alexander McLeod Wiseman. The output electrode or anode consists of two plates P, P arranged upon opposite sides of the filament and close to it. It will be noted that the input electrode is not located between the filament and plate, such not being necessary in this high current type of tube.

Fig. 7 is a diagram of an amplifying system in which a tube V of the type shown in Fig. 1 is employed. The tube has the usual input circuit 4, 4 and output circuit 5, 5. The usual arrangement of input and output circuits is that shown in Patent 1,120,942 to this applicant. In this patent there is shown and claimed a combination of the systems of the types shown in Figs. 7 and 8 respectively of this application, such combination having marked advantages for certain purposes specified in said patent. The purpose of the present application is to specifically describe and claim those types of systems employing novel thermionic amplifiers, these being capable of more general use than that disclosed and claimed in the above mentioned patent.

A source of potential 7 may be inserted in the input circuit to bring the grid to a desired initial or working potential. No transformer need be used, the incoming line being directly connected to the input electrodes, and the outgoing line, to the output electrodes. A high resistance element 6 may be connected across the input circuit as shown. A coil 8 of large inductance provides a path for direct current for the tube V, such current being supplied by a source S. The coil 8 will not conduct an appreciable amount of the variable current in the output circuit owing to its high impedance to such current. The condenser 9 is inserted in the line to prevent flow of direct current from the source S through the receiving device 10 if the latter does not itself prevent such flow.

The receiving device 10 may be one which operates most efficiently upon high variable voltage and low current. In accordance with the principles discussed above, the grid 1 and cathode 2 are placed very close together while the plate 3 is widely separated from the cathode, the distance between the two being that necessary to give the desired current and voltage output characteristics. It is usually necessary however for efficient operation to consider first the impedance characteristics of the tube between filament and plate and the receiving device and line, in accordance with the fourth principle of operation stated above. The receiving device 10 is one of high impedance and correspondingly the impedance of the tube between filament and plate is made high, the two impedances being made as nearly the same as possible consistent with other possible conflicting requirements. They should at least be of the same order of magnitude, for example one being 100,000 ohms and the other 25,000 ohms. The receiving device 10 may be a second amplifying tube or similar device.

Fig. 8 is a diagram of a system the same as that of Fig. 7 except that a receiving device having relatively low impedance or operating efficiently upon relatively large variable current and low voltage, or both, is present. Accordingly, the grid P' and cathode F' of the tube are placed relatively

near together, the grid 1ª being as before very close to the cathode. The impedance of the amplifier between filament and plate is made the same as that of the receiving device 11, or as nearly the same as other operating conditions will permit, and at least of the same order of magnitude.

It has been found that in accordance with this invention an amplifier of the type shown in Fig. 7 may be constructed which will deliver receiving energy at a voltage one thousand times that of the input energy and having an impedance to the primary source of the input energy which is of the same order of magnitude as that of the receiving device, such as an amplifier only three stages of which efficiently feeds a receiving device of very relatively low impedance and corresponding with a receiving device of even much lower impedance would be relatively high—much higher than that heretofore attainable.

Fig. 9 shows the same circuit as Fig. 7 except that a high resistance element 18 is substituted for the coil 5, this resistance being so large that the variable current through it is negligible. The high-current, low-voltage-amplification type of amplifier is here shown, a tube impedance of the same order as that of the telephone receiver 15 being thus obtained.

In Fig. 10 is shown a system similar to that of Fig. 8 except that input and output transformers, 19 and 19 respectively, are employed. Except for the tube structure, system of this kind have been in use for some time. The elements of the tube are here spaced and the grid constructed in accordance with the principles herein described, the construction of the tube being of the type illustrated in Fig. 2. The secondary of the input winding 17 of the transformer 19 is here accordingly the cathode-anode impedance is made of the same order as that of the number of turns of coil 18 in the input 17 being the same as the number of turns of the primary winding 18. A [illegible] dynatron [illegible] upon current, [illegible] that the type of [illegible] An impedance coil 20 may be connected in series with the source of [illegible] current variations [illegible] of the amplifier. [illegible] of frequency [illegible] variable current [illegible] the coil 20 may [illegible] from. If the impedance of the primary coil 17 is high, as might be the case if a [illegible] the [illegible] V would of course be [illegible] desired amount.

By [illegible] appears [illegible] a receiver depending for its operation upon current discharge from a heated cathode. It is obvious, however, that the invention might be applied to a discharge device in which other means is employed for liberating electrons from the cathode. In its broadest aspect the invention is not limited to the particular structure herein illustrated, but may be found useful in modified forms or types of discharge tubes and in connection with a variety of circuit arrangements.

What is claimed is:

1. A thermionic discharge tube having a cathode, an anode and a controlling electrode, said anode being located in such close proximity to the cathode that the tube operates to produce energy amplification without substantial voltage amplification.

2. A thermionic discharge tube having a cathode, an anode, and a controlling electrode, said controlling electrode and said anode being located in such close proximity to the cathode that the tube operates to produce energy amplification without substantial voltage amplification.

3. A thermionic discharge tube having a cathode, an anode and a controlling electrode, said anode being located in such close proximity to the cathode as to keep the internal impedance of the tube sufficiently low to permit of energy amplification without substantial voltage amplification.

4. The combination with a thermionic discharge tube having a cathode, an anode, and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being located so close to both said anode and said impedance varying element, that, for the impedances and voltages employed across the tube, the tube operates to amplify the energy in said input circuit without amplifying the voltage.

5. The combination with a thermionic discharge device having an anode, a cathode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit and translating means for utilizing the variable current of said output circuit, said cathode being located so close to said grid and said grid being of such fine mesh that, for the impedances and voltages employed across said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

6. The combination with a thermionic discharge tube having a cathode, an anode

and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said impedance varying element being in immediate proximity to the cathode but out of electrical contact therewith, and closer to the cathode than to the anode, so that for the impedances and voltages employed outside the tube, the tube operates to amplify the energy in said input circuit without amplifying the voltage.

7. The combination with a thermionic discharge device having a cathode, an anode and a control element, of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and control element being so spaced that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

8. The combination with a thermionic discharge device, having an anode, a cathode and a control element, of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and control element being so spaced that the impedance of said discharge device between said anode and said cathode is approximately the same as that of said outgoing circuit.

9. The combination with a thermionic discharge device having a cathode, an anode, and a control element, of an input circuit connected to said cathode and said control element, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said control element but out of electrical contact therewith, and said anode being so spaced from said cathode and control element that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

10. The combination with a thermionic discharge device having a cathode, an anode, and a grid of an input circuit connected to said cathode and said grid, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said grid but out of electrical contact therewith, and said anode being so spaced from said cathode and grid and the said grid being of such coarse mesh that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

11. The combination with a thermionic discharge device having a cathode, an anode and a control element, of an input circuit connected to said cathode and said control element, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said control element but out of electrical contact therewith, and said anode being so spaced from said cathode and control element that the impedance of said discharge device between said anode and said cathode is approximately the same as that of said outgoing circuit.

12. The combination with a thermionic discharge device having a cathode, an anode, and a control element, of an input circuit connected to said cathode and said control element, an outgoing circuit having impedance and connected to said anode and said cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode, anode and control element being so placed that the impedance of that portion of the input circuit which is within the discharge device is made as small as possible without introducing disturbing mechanical or electrical variations under working conditions, and the impedance of that part of the outgoing circuit which is within the discharge device is made of the same order as that of the effective impedance of that part of the outgoing circuit which is external to the discharge device.

13. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit.

14. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit

non-magnetically connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit.

15. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit, the variable power delivered to said work circuit being much greater than that supplied by said input circuit, while the variable voltage delivered is correspondingly less than in said input circuit.

16. Means for amplifying energy without substantial voltage amplification, comprising a vacuum discharge tube having an input and an output circuit, a source of variable energy to be amplified connected in said input circuit, and a translating device to which the amplified energy is delivered connected in said output circuit.

17. Means for amplifying energy without substantial voltage amplification comprising an electric discharge device having an anode, a cathode and a current control element, an input circuit and an output circuit for said device, a source of variable energy to be amplified connected in said input circuit, and a translating device to which the amplified energy is delivered connected in said output circuit.

18. Means for amplifying energy without substantial voltage amplification comprising an electric discharge device having an input circuit and an output circuit, a translating device to which the amplified energy is delivered connected in said output circuit, the impedance of that portion of said output circuit which is within said discharge device being of the same order of magnitude as the impedance of said translating device.

19. The combination with an electronic discharge device having an anode, a cathode and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said impedance varying element being in the form of a discontinuous conductive surface, the ratio of conductive surface to space-space being so low that, for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

20. The combination with an electronic discharge device having a cathode, an anode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said anode being so close to said cathode and said grid being of such course mesh that, for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

21. The combination with a thermionic discharge device having a cathode, an anode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being located in immediate proximity to said grid but out of contact therewith, and the grid being of such course mesh, that, for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

22. The combination with an electronic discharge device having a cathode, an anode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being placed in immediate proximity to said grid, but out of contact therewith, said anode being so close to said cathode, that for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

23. The combination with an electronic discharge device having a cathode, an anode and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit and translating means for utilizing the variable current of said output circuit, said cathode, anode and impedance varying element being so spaced that for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

24. Means for amplifying energy without substantial voltage amplification comprising

an electric discharge device having an anode, a cathode and a current control element, an input circuit for said device, a source of variable energy to be amplified connected in said input circuit, and a work circuit to which the amplified energy is delivered inductively connected in said output circuit.

25. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode in immediate proximity to said cathode but out of electrical contact therewith and closer to said cathode than to said output electrode.

26. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode as close as possible to said cathode without contacting therewith and closer to said cathode than to said output electrode.

In witness whereof, I hereunto subscribe my name this 29th day of July A. D., 1918.

HAROLD De F. ARNOLD.

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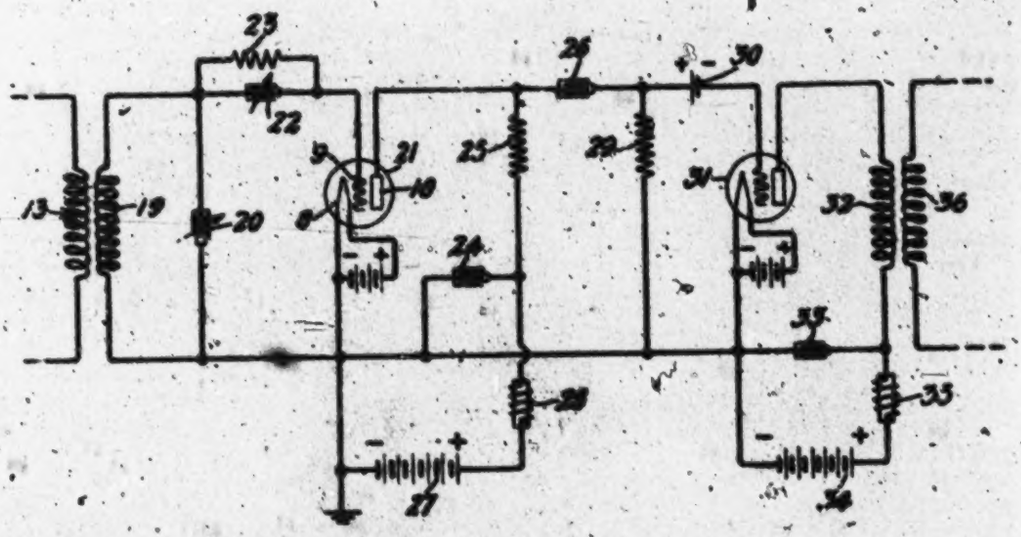
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H. D. ARNOLD.

VACUUM TUBE CIRCUITS.

APPLICATION FILED NOV 11, 1920.

1,403,475. Patented Jan. 17, 1922.



Inventor:
Harold D. Arnold
by J. R. Rutz Atty.

UNITED STATES PATENT OFFICE.

HAROLD D. ARNOLD, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

VACUUM-TUBE CIRCUITS.

1,402,475. Specification of Letters Patent. Patented Jan. 17, 1922.

Original application filed September 3, 1915, Serial No. 48,573. Divided and this application filed November 11, 1916. Serial No. 130,558.

To all whom it may concern:

Be it known that I, HAROLD DE F. ARNOLD, a citizen of the United States, residing at Maplewood, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Vacuum-Tube Circuits, of which the following is a full, clear, concise, and exact description.

This invention relates to vacuum tube circuits and particularly circuits of the type in which a plurality of vacuum tubes are arranged in tandem.

The object of the invention is to provide an improved circuit connection between vacuum tubes whereby fluctuations of current in the output circuit of one vacuum tube may be impressed on the input circuit of another vacuum tube.

In accordance with this invention, the output circuit of a vacuum tube is provided with a path for direct current comprising an impedance, preferably a resistance and the input circuit of the succeeding tube is connected across a portion of the direct current path containing said impedance. A condenser is placed between the direct current circuit and the second tube to prevent the flow of direct current, and a direct connection is also made between the input electrodes of the second tube so that a normal potential difference may be applied therebetween.

This type of connection is also useful for connecting circuits of various kinds either with the input terminals or the output terminals of a vacuum tube.

The invention further resides in the specific details of the circuit hereinafter to be described, and shown in the accompanying drawing, in which the figure represents, schematically, a circuit embodying the invention.

The subject matter of this application is divided out of application Serial No. 48,573, filed September 3, 1915, for radio communication.

Reference numerals are used in this application corresponding to those used in the application above referred to.

This application is a continuation in part of my application Serial No. 247,622, filed July 30, 1918, now Patent No. 1,329,283, dated January 27, 1920.

Coil 13, which may be connected to any suitable circuit upon which electric impulses may be impressed is inductively connected with the tuned circuit comprising coil 19 and condenser 20. Across the terminals of condenser 20, is connected the input circuit of a detecting device which comprises vacuum tube 21, condenser 23 and resistance 22. For the detection of modulated high frequency signals the purpose of the combination of the condenser and high resistance in connection with vacuum tube 21 is as follows—when a positive charge, for example, is forced upon the grid 9 of element 21, this charge is neutralized by electrons from the filament 8. Then, when a negative charge is forced upon the grid by the incoming wave, this charge adds to that already present and produces a still larger negative charge upon the grid, since the negative charge cannot be neutralized by the electron stream. The condenser, therefore, aids in decreasing the average current in the output circuit. The grid must, however, be conductively connected to the incoming circuit, otherwise the accumulated negative charge would remain and prevent further operation. To provide for this, a high resistance leakage path 23 is shunted around the condenser 23 to allow a leak, slow compared with the period of high frequency currents, but still rapid enough to permit considerable leakage in a time comparable with a period of telephonic waves.

The output circuit of this vacuum tube is supplied with current by battery 27 coming through choke coil 28 and resistance 25, to the anode 10 condenser 24 serving as a high frequency shunt and condenser 26 to limit the direct current to the detector circuit. The amplifier tube 31 has a battery 30 in series with its grid with resistance 29 across its input circuit. The output circuit of amplifier 31 comprises a battery 34 and choke coil 35, both shunted by condenser 33, and a coil 32. Coil 32 is inductively associated with coil 36 may be connected to any suitable circuit for the utilization of the amplified currents.

While a circuit has been shown which is especially adapted for the detection and amplification of modulated high frequency currents, it is obvious that the features of the circuit relating to the object of this invention are adapted for use in repeating electrical impulses of other forms.

What is claimed is:

1. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and an impedance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said impedance, and means for applying a steady difference of potential between said input electrodes.

2. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and a resistance connected to said electrodes, and a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said resistance, and means for applying a steady difference of potential between said input electrodes.

3. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and an impedance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said impedance, and a conductive path between the input electrodes of said second tube.

4. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and a resistance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said resistance, and a conductive path between the input electrodes of said second tube.

5. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and a resistance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across that portion of said first path comprising said resistance and said source of direct potential, and a conductive path between the input electrodes of said vacuum tube.

6. In combination, two vacuum tubes, a circuit connecting the output electrodes of one of said tubes to the input electrodes of the other of said tubes, said circuit comprising a series condenser and a shunt impedance at each side of said condenser.

7. In combination, two vacuum tubes, a circuit connecting the output electrodes of one of said tubes to the input electrodes of the other of said tubes, said circuit comprising a series condenser and a shunt path at each side of said condenser, each of said paths comprising a resistance.

8. In combination a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser.

9. In combination, a circuit comprising a resistance, a source of direct current and means for producing variations in said current, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser.

10. In combination, a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, connections for impressing said variations on said electrodes, said connections comprising a series condenser, and a resistance shunt for said input electrodes.

11. In combination, a circuit for the reception of modulated high frequency currents, a vacuum tube for detecting and amplifying said currents, said vacuum tube having an impedance in its output circuit, and a circuit connected substantially in parallel with said impedance for impressing variations in the output circuit on another amplifier, said second circuit comprising a series condenser.

12. In combination, a circuit for the reception of modulated high frequency currents, a vacuum tube for detecting and amplifying said currents, said vacuum tube having an impedance in its output circuit, a circuit connected substantially in parallel with said impedance for impressing variations in the output circuit on another amplifier, said second circuit comprising a series condenser, and a shunt conductance.

13. A detector and amplifier of high frequency currents having in its output circuit a source of direct current, an inductance and a resistance in series, an amplifier having its input circuit in parallel with said series circuit, and a path of low impedance having one terminal in common with said circuits, and its other terminal connected between said resistance and said inductance.

14. A detector and amplifier of high frequency currents having in its output circuit a source of current and an inductance, a translating device having an input circuit connected in parallel to a portion of said output circuit containing said inductance, and a path of low impedance to high fre-

quency current connected in parallel to a portion of said output circuit containing said inductance.

15. In combination, a vacuum tube having output electrodes, a path for direct current comprising said output electrodes, a source of current and an impedance, and a path for alternating currents comprising a condenser and a work circuit, said second path being in parallel to a portion of said first path containing said impedance.

In witness whereof, I hereunto subscribe my name, this 5th day of November, A. D. 1920.

HAROLD D. ARNOLD.

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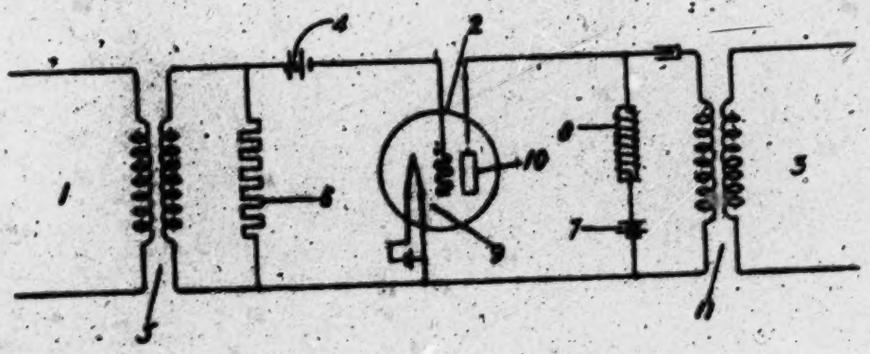
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Mar. 13, 1923. 1,448,550

H. D. ARNOLD.

THERMIONIC AMPLIFIER CIRCUITS.

FILED FEB. 3, 1919.



Inventor:
Harold D. Arnold
by [illegible] Atty

Patented Mar. 13, 1923. 1,448,550

UNITED STATES PATENT OFFICE.

HAROLD D. ARNOLD, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

THERMIONIC AMPLIFIER CIRCUITS.

Application filed February 8, 1919. Serial No. 276,750.

To all whom it may concern:

Be it known that I, HAROLD D. ARNOLD, a citizen of the United States, residing at Maplewood, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Thermionic Amplifier Circuits, of which the following is a full, clear, concise, and exact description.

The invention relates to repeater circuits wherein an electron-discharge device is employed for receiving comparatively weak incoming impulses and for transmitting them in the same form or in a magnified form but with amplified energy. Such an amplifier which has a cathode, an anode and a control member usually in the form of a grid electrode, had a very high impedance between control member and cathode which are the usual input electrodes. This impedance is of the order of 25,000 ohms or more being in the nature of a space discharge path between electrodes in a vacuum. Preferably, the vacuum is as perfect as practicable, substantially no positive ionization taking place during the operation of the device. In case a source of potential is employed for making the potential of the grid always negative, the input circuit impedance is of the order of infinity, for no electrons can flow from the filament to an electrode which is negative, so that no current flow takes place between cathode and grid even though the latter does respond to the incoming potential variations.

An object of the present invention is to modify the effect of this high input impedance so that it may have any desired finite value.

This is accomplished by connecting the incoming line to the repeater through a transformer, the secondary coil of which is shunted by a high impedance preferably a resistance of the order of 500,000 ohms, and may, for instance, range from approximately 100,000 ohms to 1,000,000 ohms. This resistance is also in shunt to the input electrodes. The impedance between the input electrodes may be made much higher than 500,000 ohms by a battery or other source which maintains the grid negative. The impedance of the secondary coil of the transformer is practically that of the 500,000 ohm resistance, as the higher impedance path between the input electrodes takes practically no current or at least a negligible current.

By this arrangement the same amplification can be secured with amplifier tubes having different input impedances, and it is possible to substitute one such tube for another in a given circuit arrangement.

More uniform amplification may also be secured by this arrangement with varying input power. In the use of amplifier circuits heretofore designed it has been found that there is a tendency for small input voltages to be amplified proportionately more than large input voltages, for the reason that the input impedance of the tube is greater for small voltages than for large voltages, especially when no means is employed for maintaining the control electrode negative with respect to the cathode. By the use of a shunt path of resistance less than that between the input electrodes this tendency is substantially eliminated.

Aside from the above mentioned advantages of using the shunt impedance, it has the advantage, regardless of the function of the vacuum tube or of the circuit in which it is connected, of preventing singing of the repeater in case the output and input circuits thereof are coupled either designedly by an inductive coupling for instance, or accidentally by reason of the proximity of the input and output leads of the repeater.

A further advantage inherent in the use of a high impedance shunt between the line and the repeater is that it is possible to employ vacuum tubes having different but high impedances in the same circuit without substantially affecting the impedance of the circuit as seen from the primary side of the transformer.

This application is a continuation in part of application, Serial No. 39,210, filed November 2, 1915, and of application Serial No. 48,474, filed September 2, 1915.

For further details of the invention, reference may be made to the drawings in which the single figure illustrates diagrammatically a repeater circuit embodying the invention.

Referring in detail to the figure, the incoming line 1 is adapted to be traversed by weak incoming impulses which are to be amplified by the amplifier 2, and to be sent out in amplified form upon the line 3. Pref-

erably, there is employed the battery 4 or other source which maintains the grid negative with respect to the cathode, in which case the input impedance of the repeater is practically infinite, as described above. The line 1 is connected to the input electrodes of the repeater which, in this case, are the grid and cathode electrodes, by the repeating coil or transformer 5. In shunt to the secondary of the repeating coil 5 and also in shunt to the input electrodes is the impedance 6, which may be non-inductive as shown and in the form of a resistance of the order of 500,000 ohms. This resistance may assume any desired form; viz, it may be a wire resistance, a lamp resistance, or a piece of paper stamped with india ink and sealed in a glass tube. The battery 7 in the output circuit of the repeater supplies space current through the choke coil 8 and between cathode 9 and anode 10. If desired, the output circuit of the repeater may be coupled to the line 2 by the repeating coil 11, as shown.

What is claimed is:

1. The combination of a vacuum discharge repeater of the three-electrode type, an inductive coil conductively connected to the input electrodes of said repeater, and a non-inductive impedance in shunt to said coil.

2. The combination of an incoming line, an electric discharge repeater of the three-electrode type, a transformer coupling said line to said repeater, one coil of said transformer being conductively connected to the input electrodes of said repeater, and a non-inductive impedance in shunt to one of the coils of said transformer.

3. The combination of an incoming line, an electric discharge repeater of the three-electrode type, a transformer coupling said line to said repeater, the secondary coil of said transformer being conductively connected to the input electrodes of said repeater, and a non-inductive impedance in shunt to said secondary coil.

4. The combination of a line, a vacuum tube amplifier of the three-electrode type comprising a thermionic element, said amplifier having its input terminals, means for applying a steady difference of potential between said input terminals, and a high resistance connected to said terminals.

5. The combination of a line, a vacuum tube amplifier comprising a thermionic element, said amplifier having grid and cathode electrodes, means for applying a steady difference of potential between said electrodes, and a non-inductive impedance of the order of magnitude of 500,000 ohms forming a by-path between said electrodes.

6. The combination of an incoming line, a repeater having a cathode and an anode, means for applying a space current between said cathode and anode, means for applying a steady difference of potential between said cathode and said grid electrode, and a high resistance by-path for said grid and cathode.

7. The combination of a line, a vacuum tube amplifier, a transformer for connecting said line to said amplifier, a by-path between said line and said amplifier and having an impedance of the order of 500,000 ohms, and means for maintaining the impedance of said amplifier greater than that of said by-path.

8. The combination of an incoming line, a repeater having a cathode and an anode, means for applying a space current between said electrodes, a member for controlling said space current, means for applying a steady difference of potential between said cathode and said control member and means between said line and said repeater for making the impedance of the repeater as seen from said line, substantially of a constant value.

9. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said cathode and anode, a grid electrode for controlling said space current, means for making said grid negative with respect to said cathode, and means between said line and the input electrodes for making the impedance of said amplifier as seen from said line, substantially of a constant value.

10. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said cathode and anode, a grid electrode for controlling said space current, means for making said grid negative with respect to said cathode, a transformer for connecting said line to said amplifier, and a high resistance by-path for the secondary winding of said transformer and said grid and cathode electrodes for making the impedance of said amplifier as seen from said line, substantially of a constant value.

11. The combination of a line, an amplifier in circuit therewith having an input impedance at least as high as 100,000 ohms, and a shunt between said line and said amplifier having an impedance of an order lower than that of the input impedance of said amplifier.

12. The combination of a line, an amplifier in circuit therewith having an input impedance which is practically infinite, and a shunt between said line and said amplifier having an impedance of the order of magnitude of 500,000 ohms.

In witness whereof, I hereunto subscribe my name this 11th day of January, A. D. 1922.

HAROLD D. ARNOLD.

PLAINTIFF S' EXHIBIT No. 1 G

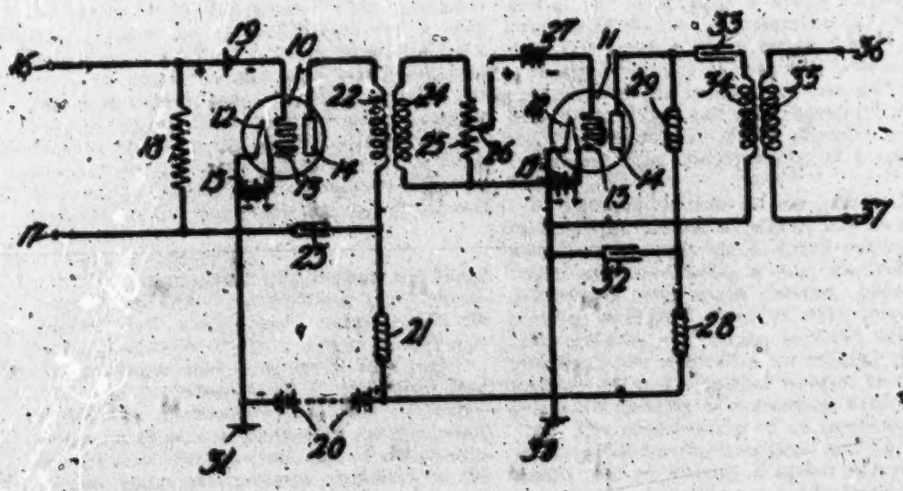
643

Aug. 21, 1923. 1,465,332

H. DE F. ARNOLD

VACUUM TUBE AMPLIFIER

Original Filed Sept. 5, 1915



Inventor:
Harold D. Arnold.
By W. G. Beattie Atty

Patented Aug. 21, 1923. 1,465,332

UNITED STATES PATENT OFFICE.

HAROLD DE FOREST ARNOLD, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

VACUUM-TUBE AMPLIFIER.

Original application filed September 3, 1915, Serial No. 48,873. Divided and application filed March 28, 1919, Serial No. 285,887. Divided and this application filed August 26, 1920. Serial No. 406,555.

To all whom it may concern:

Be it known that I, HAROLD D. ARNOLD, a citizen of the United States, residing at Maplewood, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Vacuum-Tube Amplifiers, of which the following is a full, clear, concise, and exact description.

This invention relates to vacuum tube amplifiers, and more particularly to arrangements for supplying space current thereto.

An object of this invention is to provide means whereby a plurality of vacuum tubes to be used as repeaters or amplifiers may be supplied with space current from a single source, but in such a manner that current changes in one tube due to signals being repeated cannot be impressed upon another tube through said source.

With the arrangement shown herein, a single source of space current is used to energize both tubes of a two stage amplifier, and in the branches of the circuit therefore are interposed filters of series inductance and shunt capacity to prevent alternating current from being bypassed therethrough.

The invention described and claimed herein is divided out of my applications, Serial No. 48,873, filed September 3, 1915, and Serial No. 285,887, filed March 28, 1919.

For further details, reference may be made to the accompanying drawings in which the single figure illustrates diagrammatically a two stage amplifier embodying the invention.

Referring to the drawing by reference numerals, the amplifier set comprises a tandem arrangement of two vacuum tubes 10 and 11 each having cathode 12, a grid or control electrode 13, and an anode 14. The cathodes 12 are maintained in a condition of thermionic activity by currents from sources 15.

The input circuit of tube 10 comprises terminals 16, 17, adapted to be connected to a suitable source of electric impulses to be repeated, a resistance 18 bridged across the input electrodes, and a battery 19 adapted to maintain the grid electrode at a negative potential with respect to the cathode. Current between the anode and cathode is supplied from battery or other suitable source 20, the current passing in series through the inductance 21 and the transformer primary 22. A shunt condenser 23 provides a path for the alternating current.

The transformer secondary 24 has connected across its terminals a resistance 25, one end of which is connected to the cathode of tube 11. A connection from resistance 25 to the grid of tube 11 comprises the movable contact 26 and the battery 27, the function of the latter being to provide the necessary negative potential on the grid.

Direct current is supplied to the tube 11 from source 20, through inductances 28 and 29, and grounds 30 and 31. Condenser 32 is shunted across the direct current circuit. The output circuit for alternating current comprises the condenser 33 and the primary 34 of a transformer, the secondary 35 of which is adapted to be connected through terminals 36 and 37 to any suitable receiving circuit.

In operation, the signals or other impulses, which are repeated and amplified by the tube 10, are impressed on the resistance 25 by currents induced in the secondary coil 24. The input electrodes of the second tube are shunt to an adjustable part of the resistance 25, and therefore any desired proportionate part of the potential drop across the resistance may be impressed between the input electrodes, with the result that the ratio of amplification may be varied between a predetermined maximum and zero.

The series inductances 21 and 28 and the shunt condensers 23 and 32 serve to prevent potential variations from the source or from either tube without being impressed through the supply circuit on the other tube.

While I have shown and described one embodiment of the invention, it is obvious that it may assume any desired form within the scope of the appended claims.

What is claimed is:

1. In combination, a plurality of vacuum tube repeaters, a common source of space current for said repeaters, the circuit between one of said repeaters and said source comprising series inductance, and a path comprising capacity bridged across said circuit between said source and said repeater.

2. In combination, a plurality of vacuum tube repeaters, a common source of space current for said repeaters, the circuit be-

tween each of said repeaters and said source comprising series inductance, and a path comprising capacity bridged across each of said circuits between said source and the respective repeaters.

2. In combination, a plurality of vacuum tube repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from one of said repeaters from flowing in the portion of the space current circuit common to said repeaters.

4. In combination, a plurality of vacuum tube repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from flowing from each said repeaters to the others of said repeaters through the portion of the space current circuit common to all.

5. In a multi-stage amplifier, a plurality of vacuum tubes connected in tandem, a common source of space current for said tubes, branch circuits connecting said source and said tubes, and a filter comprising series inductance in one of said circuits and a path containing capacity bridged across the circuit between one of said tubes and said source.

6. In a multi-stage amplifier, a plurality of vacuum tubes connected in tandem, a common source of space current for said tubes, branch circuits connecting said source and said tubes and a filter comprising series inductance in each of said circuits and a path containing capacity bridged across each of said circuits between each of said tubes and said source.

7. In combination, a plurality of vacuum tube translating devices, a common source of potential for said vacuum tubes, a circuit connecting each of said tubes to said source containing series inductance and a path comprising capacity bridged across each of said circuits.

8. In combination, a plurality of vacuum tube translating devices, a common source of current for energizing said tubes, and a path comprising capacity bridged across each of the circuits connecting said tubes to said source.

9. In combination a plurality of vacuum tube translating devices, a common source of current for energizing said vacuum tubes, each of the circuits between said tubes and said source comprising series impedance, and a capacity effectively in shunt to said source for preventing interference between said tubes.

10. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers in succession from the last to the first of said amplifiers, and filter connections between successive amplifiers of the series.

11. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers, and filter connections between successive amplifiers of the series.

In witness whereof, I hereunto subscribe my name this 28th day of August A. D., 1920.

HAROLD DE FOREST ARNOLD.

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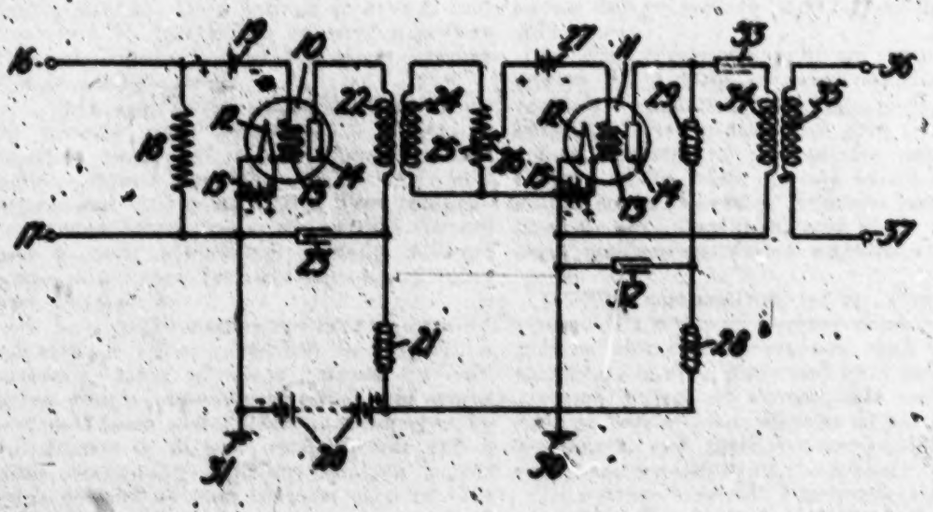
646

Dec. 30, 1924. 1,520,994

H. D. ARNOLD

ELECTRON DISCHARGE AMPLIFIER

Original Filed Sept. 3, 1915



Inventor:
Harold D. Arnold
by [illegible] Atty.

Patented Dec. 30, 1924. 1,520,994

UNITED STATES PATENT OFFICE.

HAROLD D. ARNOLD, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRON-DISCHARGE AMPLIFIER.

Original application filed September 4, 1918, Serial No. 252,572. Divided and this application filed March 19, 1919. Serial No. 283,337.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at Maplewood, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Electron-Discharge Amplifiers, of which the following is a full, clear, concise, and exact description.

This invention relates to electron discharge devices, and more particularly to an arrangement for and method of varying the ratio of amplification of an electron discharge amplifier.

It is an object of the invention to provide means whereby the ratio of amplification can be varied without varying the impedance presented by the amplifier as a whole to the impulses which are to be amplified.

This is accomplished in the preferred form of the invention by the use of an impedance shunted across the terminals of the secondary of a transformer used to step up the voltage of the incoming currents. The cathode of an electron discharge tube of the three-electrode type is connected to one end of this impedance, and a connection is made from the control electrode by means of an adjustable contact to a desired point on the impedance, thus varying the proportionate part of the potential drop across the impedance which is applied between the control electrode and the cathode, and correspondingly varying the amplification in the output circuit of the tube.

A specific feature of my invention is the interposition of the above described controlling arrangement in the output-input coupling between two stages of a multi-stage amplifier. With this arrangement, a single source of space current is used to energize both tubes, and in the branches of the circuit therefor are interposed filters of proper inductances and shunt capacity to prevent alternating current from being bypassed therethrough.

The invention described and claimed herein is divided out of my application Serial No. 252,572, filed September 4, 1918, issued as Patent No. 1,464,287, August 21, 1923. The invention claimed herein is related to the invention claimed in my pending application Serial No. 271,750, filed February 2, 1919, issued as Patent No. 1,468,800, March 18, 1923.

For further details, reference may be made to the accompanying drawings in which the single figure illustrates diagrammatically a two stage amplifier embodying the invention.

Referring to the drawing by reference numerals, the amplifier set comprises a tandem arrangement of two vacuum tubes 10 and 11 each having a cathode 12, a grid or control electrode 13, and an anode 14. The cathodes 12 are maintained in a condition of thermionic activity by currents from sources 15.

The input circuit of tube 10 comprises terminals 16, 17, adapted to be connected to a suitable source of electric impulses to be repeated, a resistance 18 bridged across the input electrodes, and a battery 19 adapted to maintain the grid electrode at a negative potential with respect to the cathode. Current between the anode and cathode is supplied from battery or other suitable source 20, the current passing in series through the inductance 21 and the transformer primary 22. A shunt condenser 23 provides a path for the alternating current.

The transformer secondary 24 has connected across its terminals a resistance 25, one end of which is connected to the cathode of tube 11. A connection from resistance 25 to the grid of tube 11 comprises the movable contact 26 and the battery 27, the function of the latter being to provide the necessary negative potential on the grid.

Direct current is supplied to the tube 11 from source 20, through inductances 28 and 29, and grounds 30 and 31. Condenser 32 is shunted across the direct current circuit. The output circuit for alternating current comprises the condenser 33 and the primary 34 of a transformer, the secondary of which is adapted to be connected through terminals 36 and 37 to any suitable receiving circuit.

In operation, the signals or other impulses, which are repeated and amplified by the tube 10, are impressed on the resistance 25 by currents induced in the secondary coil 24. The input electrodes of the second tube are in shunt to an adjustable part of the resistance 25, and therefore any desired proportionate part of the potential

drop across the resistance may be impressed between the input electrodes, with the result that the ratio of amplification may be varied between a predetermined maximum and zero.

Since the grid is at a negative potential with respect to the cathode, no current can flow therebetween, and since the capacity of these electrodes is negligibly small, the impedance of the tube to the signals is substantially infinite. It is thus seen that at all positions of the contact 26 the impedance of the second amplifying unit to the incoming impulses has substantially a constant value, namely, that of the finite resistance 25.

While I have shown and described one embodiment of the invention, it is obvious that it may assume any desired form within the scope of the appended claims. For example, the first amplifying unit with its output transformer might be replaced by any suitable circuit adapted to have electric currents produced therein. Other modifications will occur to anyone skilled in the art.

What is claimed is:

1. In combination, an electron discharge relay comprising an anode, a cathode and a control electrode, a circuit containing a source of alternating current electric impulses to be relayed, an impedance in shunt to said source, and means comprising a contact movable along said impedance for effectively connecting said control electrode and said cathode across an adjustable proportion of the whole of said impedance.

2. In combination, a vacuum tube repeater, an input transformer therefor, an impedance connected across the terminals of the transformer secondary, a connection from said impedance to an electrode of said vacuum tube, and a connection from a point intermediate the ends of said impedance to another electrode of said vacuum tube.

3. In combination, an electron discharge relay having an anode, a cathode and a control electrode, a circuit containing an impedance, means for impressing alternating voltage across the whole of said impedance, and means comprising a contact movable along said impedance for effectively connecting said cathode and control electrode across an adjustable proportion of the whole of said impedance.

4. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said electrodes, said amplifier having a grid electrode for controlling said space current, means for making said grid negative with respect to said cathode, and means between said line and the input electrodes for making the impedance of said amplifier as seen from said line substantially of a constant value, said last mentioned means comprising a potentiometer arrangement including an impedance and a contact movable along said impedance for varying the voltage supplied to said input electrodes.

5. A vacuum tube repeater comprising a vacuum tube having input electrodes, an input transformer, a resistance bridged across the secondary of said transformer, a connection from one of said electrodes to said resistance, and an adjustable connection from the other of said electrodes to a point on said resistance.

6. In combination, a vacuum tube having input and output electrodes, an electric circuit including a resistance connected to one of said input electrodes, a connection from an adjustable contact on said resistance to the other of said input electrodes, means for producing an alternating current through the whole of said resistance, and means connected to said output electrodes for transmitting an amplified current of substantially the same wave form as said first mentioned current.

7. In a multi-stage amplifier, two amplifying stages each including an electron discharge amplifier, a coupling between said stages comprising a resistance effectively in the output circuit of one amplifying unit, a connection from said resistance to an electrode of the succeeding amplifying unit, and a contact movable along said resistance and connected to another electrode of said succeeding amplifying unit.

8. In a multi-stage vacuum tube amplifier, two vacuum tubes each having a cathode, an anode and a control electrode, a circuit containing a resistance effectively connected to the cathode and anode of one of said tubes, a connection from said circuit to the cathode of the other of said tubes, and a contact movable along said resistance and connected to the control electrode of said last mentioned tube.

9. In a multi-stage vacuum tube amplifier, two vacuum tubes each having input and output electrodes and a coupling therebetween comprising a transformer having its primary connected to the output electrodes of one of said tubes, a resistance connected across the secondary of said transformer, a connection from said resistance to an input electrode of the other of said tubes, and a connection from an adjustable point on said resistance to the other input electrode of said last mentioned tube.

10. In a multi-stage vacuum tube amplifier, a vacuum tube, a resistance, means for applying changes in the output voltage of said vacuum tube across said resistance, a second vacuum tube, and means for supplying a selected part of the drop in potential across said resistance to said second vacuum tube.

11. The method of operating a vacuum tube amplifier which comprises supplying alternating current to be amplified, and varying the ratio of amplification while the impedance opposed to said alternating current remains substantially constant.

12. The method of operating an electron discharge amplifier having input electrodes which comprises supplying alternating current to be amplified, maintaining the impedance opposed to said alternating current substantially constant and varying the ratio of amplification by applying a selected part of the potential of said alternating current to said input electrodes.

13. The method of operating a vacuum tube amplifier, which comprises supplying alternating current to be amplified, varying the ratio of amplification while maintaining the impedance opposed to said alternating current substantially constant and transmitting a current through the output circuit having substantially the same wave form as that of the incoming current.

14. The method of operating a vacuum tube amplifier having input electrodes which comprises supplying alternating current to be amplified, changing the potential of said current at a fixed ratio of transformation, and applying a selected proportionate part of the potential of the transformed current to said input electrodes.

15. The combination of an incoming line, an electron discharge relay of the three-electrode type, a transformer coupling said line to said relay, one coil of said transformer being inductively connected to the input electrodes of said relay, and a potentiometer arrangement in shunt to one of the coils of said transformer, said potentiometer arrangement comprising an impedance and a contact movable along said impedance for varying the voltage applied to said input electrodes without materially varying the impedance facing said line.

In witness whereof, I hereunto subscribe my name this 26th day of March, A. D. 1918.

HAROLD D. ARNOLD.

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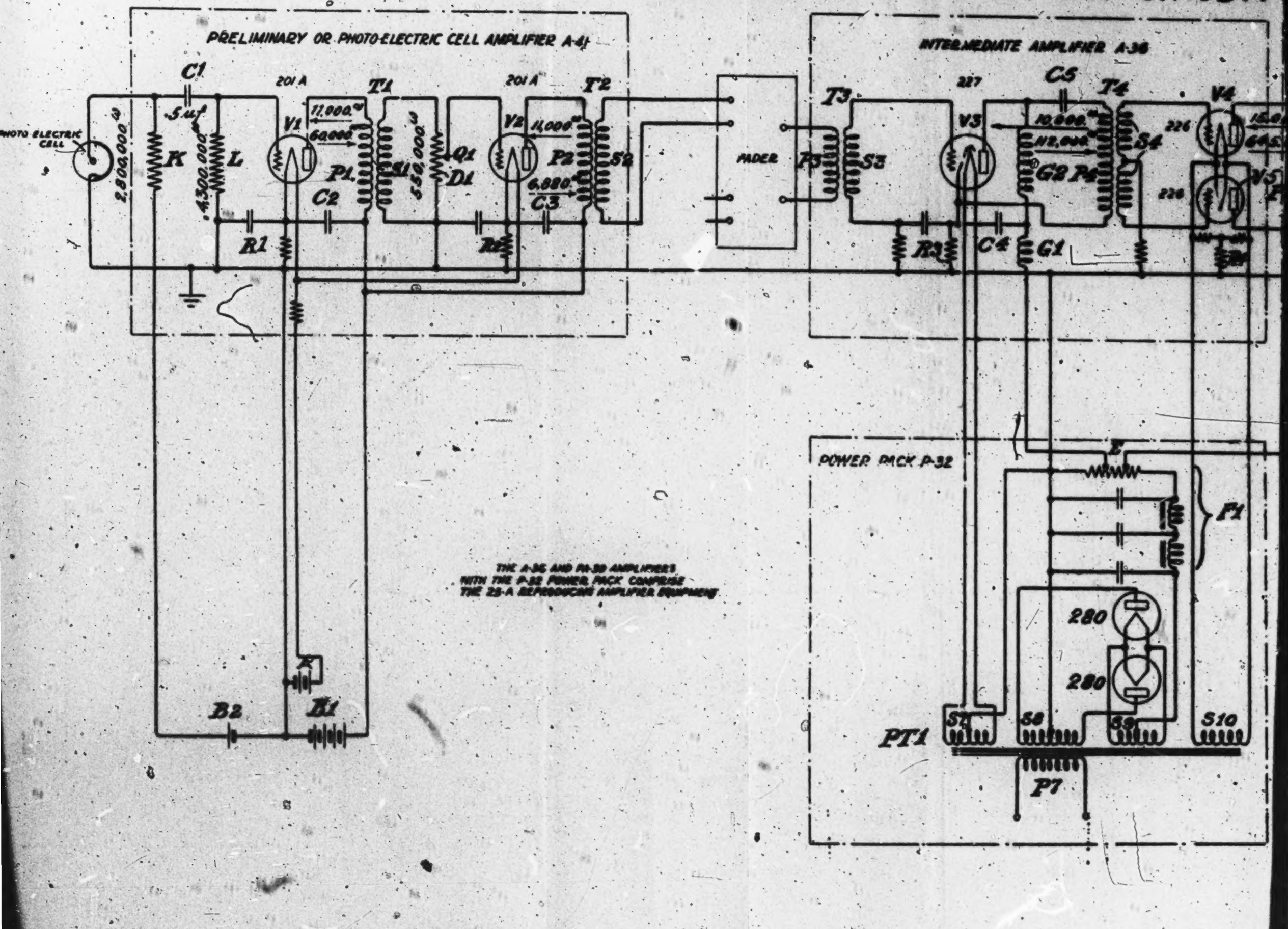
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Patents In Suit and Claims Relied Upon As To Each Part Of Defendant's Apparatus

Suit No.	Patent No.	Patentee	Descriptive Title Of Invention	Issue Date	Claims Relied Upon As To Each Part Of Defendant's Apparatus	Item No.
50-177	1,231,764	Loewenstein	Negative Grid Bias Patent	July 3, 1917	1, 2, 4, 5, 6, and 7 as to A-41, A-36 and PA-39	1
50-177	1,426,754	Mathes	Grid Biasing Resistance Patent	Aug. 22, 1922	8 as to A-41	2
50-175	1,329,283	Arnold	Power Circuit Patent	Jan. 27, 1920	7, 10 and 13 as to PA-39	3
50-175	1,349,252	Arnold	Straight Line Characteristic Patent	Aug. 10, 1920	15 as to A-41, A-36 and PA-39	4
50-178	1,403,475	Arnold	Resistance-Capacity Coupling Patent	Jan. 17, 1922	8, 9, and 10 as to A-41	5
50-175	1,448,550	Arnold	Definite Input Impedance Patent	Mar. 13, 1923	1 and 12 as to A-41	6
50-178	1,465,332	Arnold	Common Plate Supply Patent	Aug. 21, 1923	3, 8, 10 and 11 as to A-41, and 1, 3, 5, 10 and 11 as to A-36 and P-32 Power Pack	7
50-175	1,520,994	Arnold	Gain Control Patent	Dec. 30, 1924	1 and 4 as to A-41	8

650

DEFENDANT'S AMPLIFIER CIRCUIT

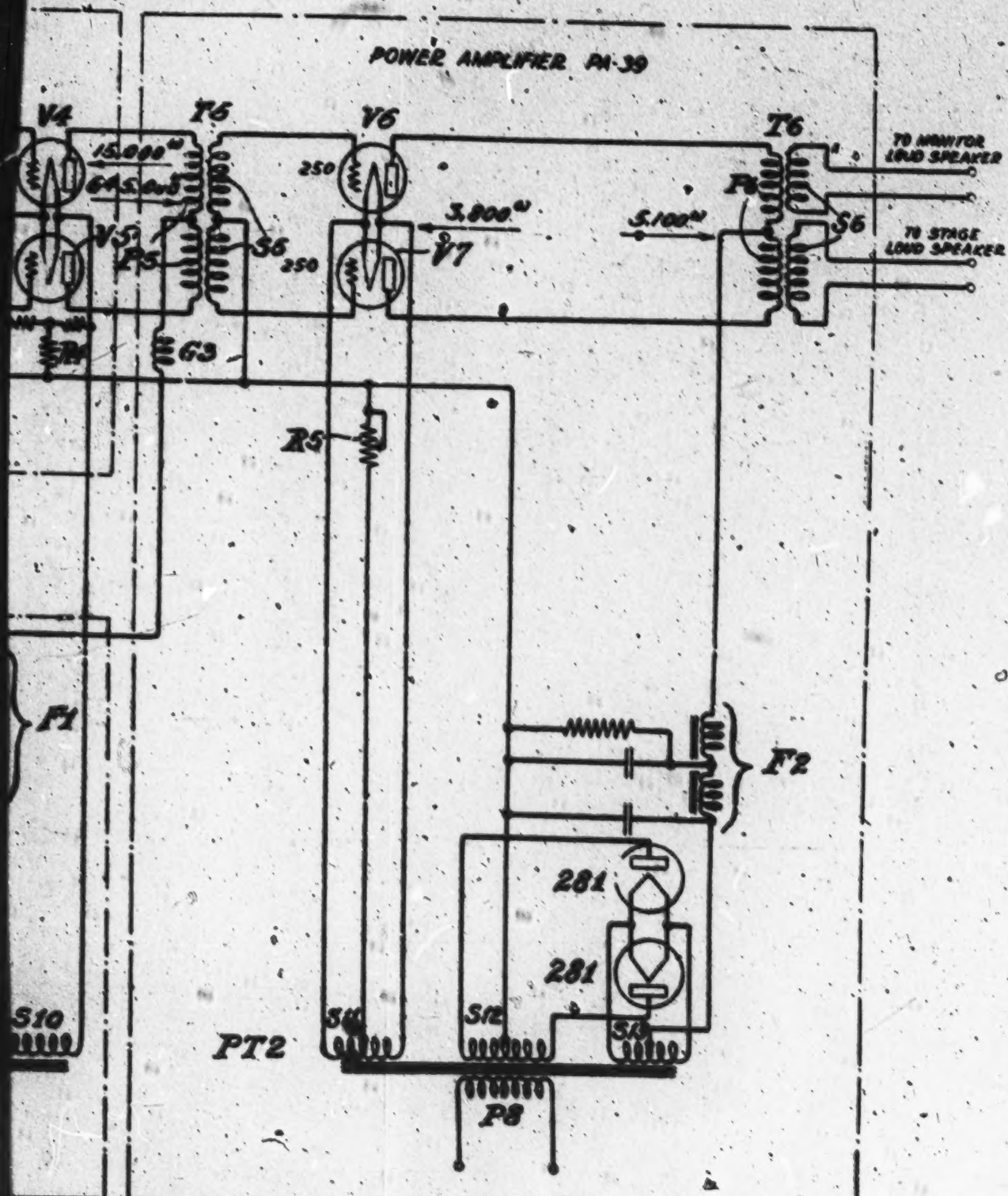


THE A-3C AND PA-39 AMPLIFIERS
WITH THE P-32 POWER PACK COMPRISE
THE 23-A REPRODUCING AMPLIFIER EQUIPMENT

PLAINTIFF'S EXHIBIT No. 2

Stipulated drawing of circuits and apparatus of defendant's amplifiers charged to infringe

CUITS.

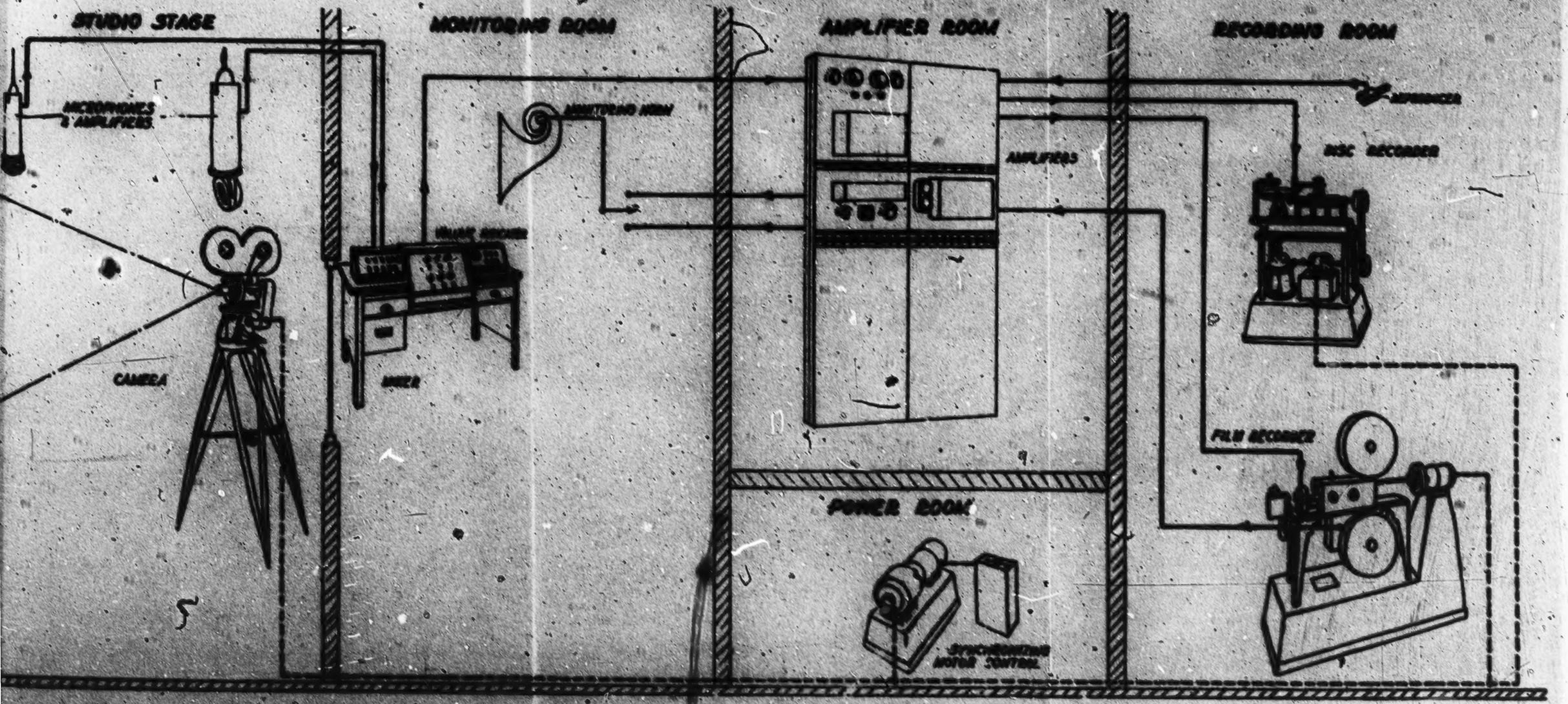


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PLAINTIFF'S EXHIBIT No. 3

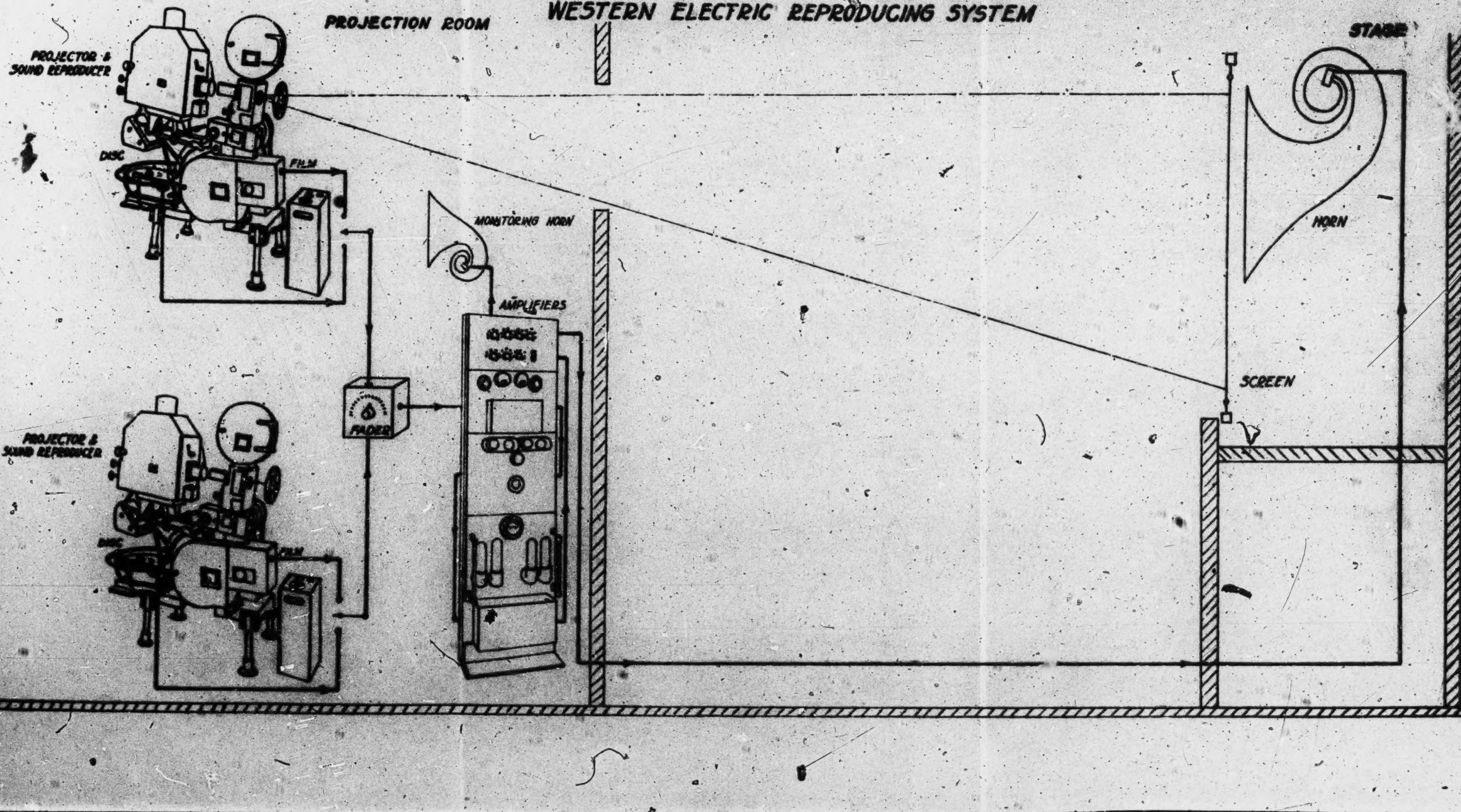
Diagram of the Western Electric Recording System.

WESTERN ELECTRIC RECORDING SYSTEM



PLAINTIFF S' EXHIBIT No. 4

Diagram of the Western Electric ~~Recording~~ Reproducing System

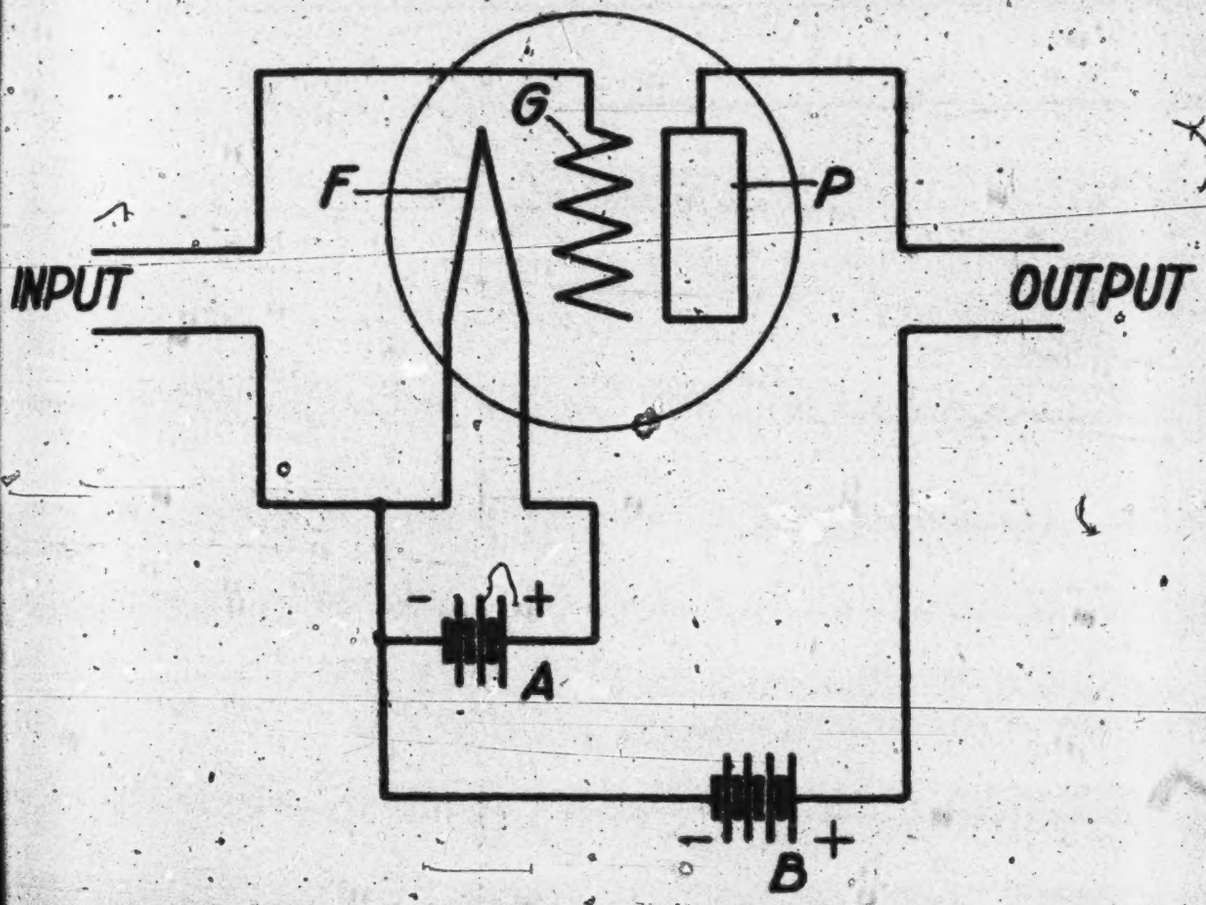


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PLAINTIFF/S' EXHIBIT No. 5

Diagram illustrating the three- electrode vacuum tube and circuits

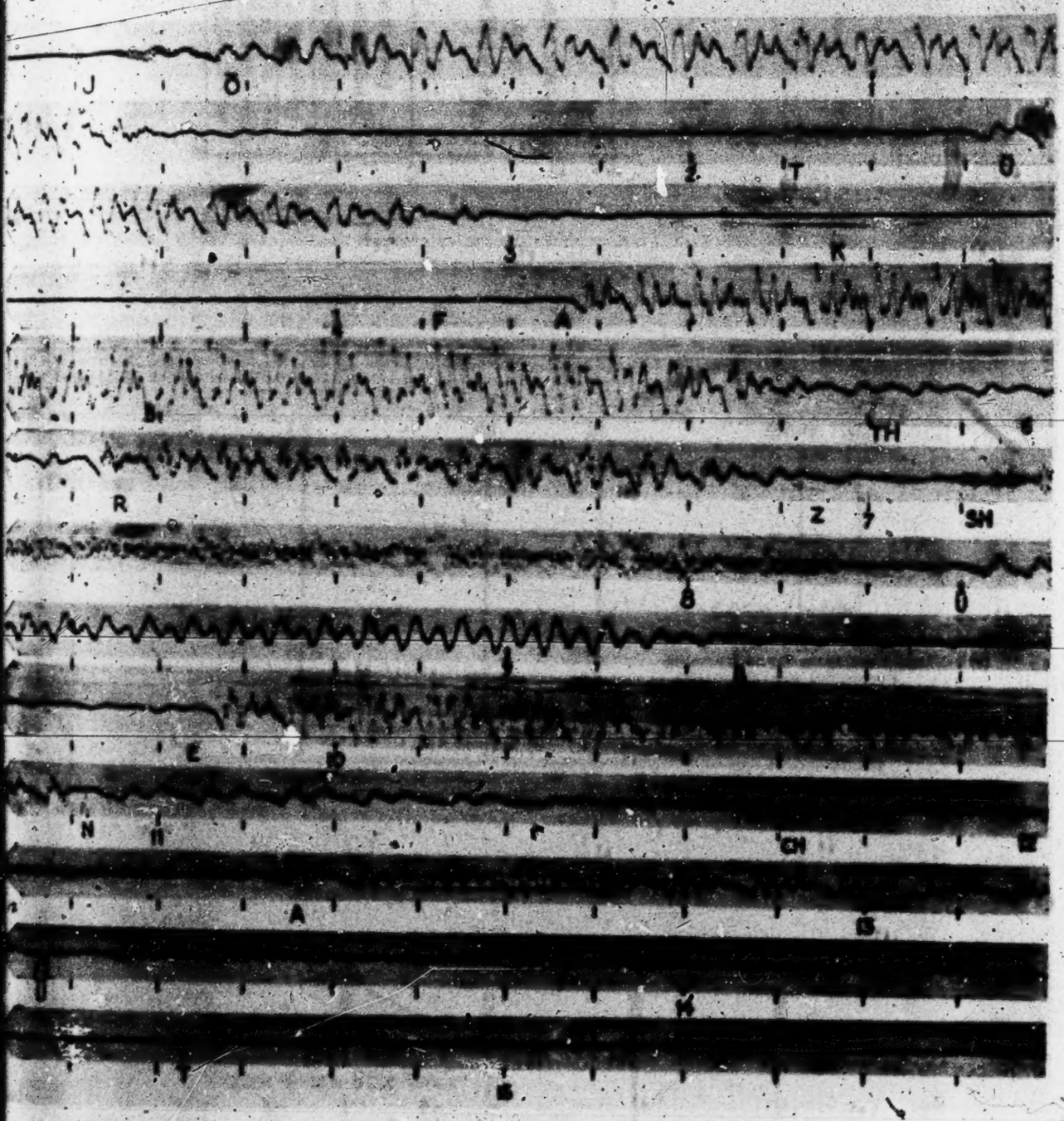


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PLAINTIFF S? EXHIBIT No. 6

Oscillograms of voice currents



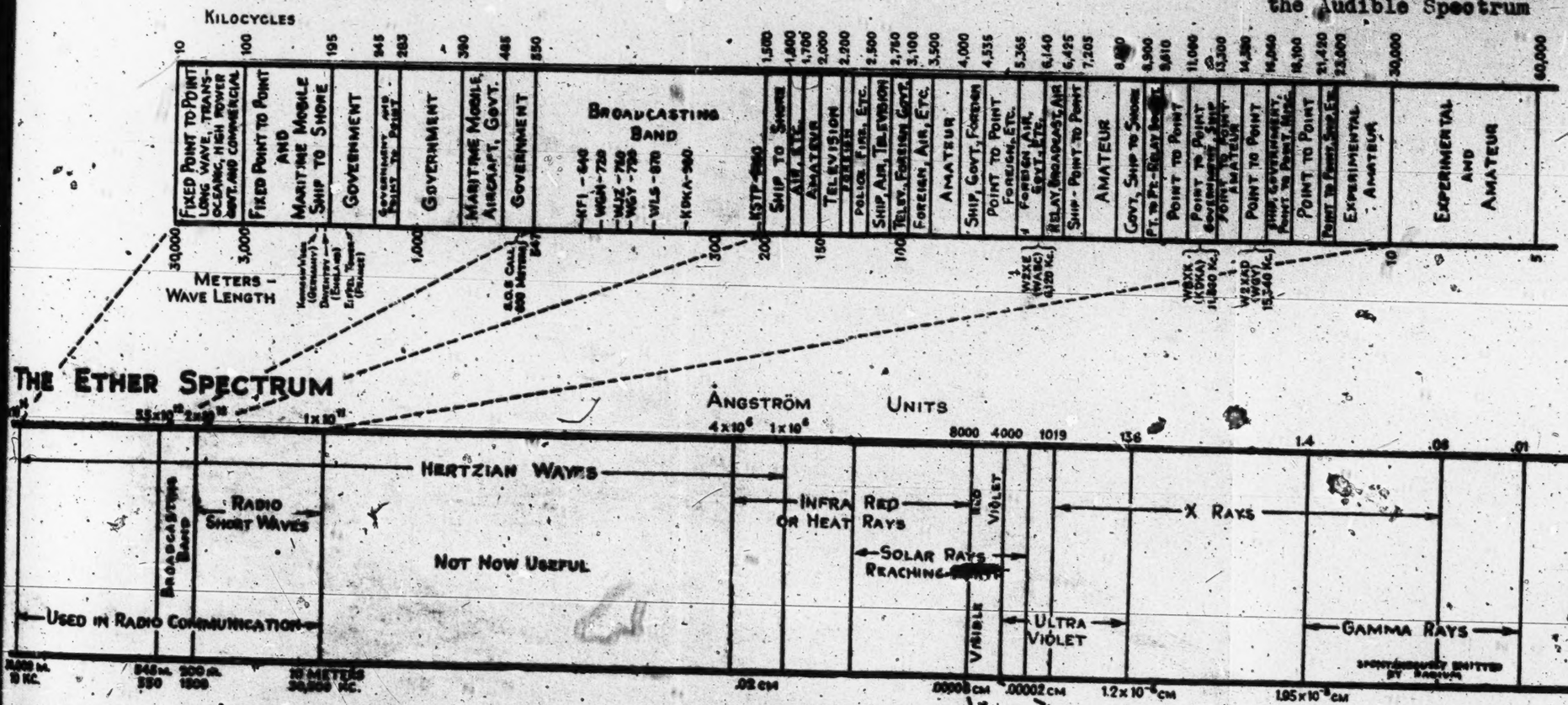
PHOTOGRAPH OF OSCILLOGRAM:
"JOE TOOK FATHER'S SHOE BENCH OUT"

TIME INTERVALS NUMBERED FOR EACH TENTH SECOND
AND SUBDIVIDED FOR EACH ONE-HUNDREDTH SECOND

45682

PLAINTIFF S' EXHIBIT No. 7

Diagram from magazine "Electronics", showing the Audible Spectrum

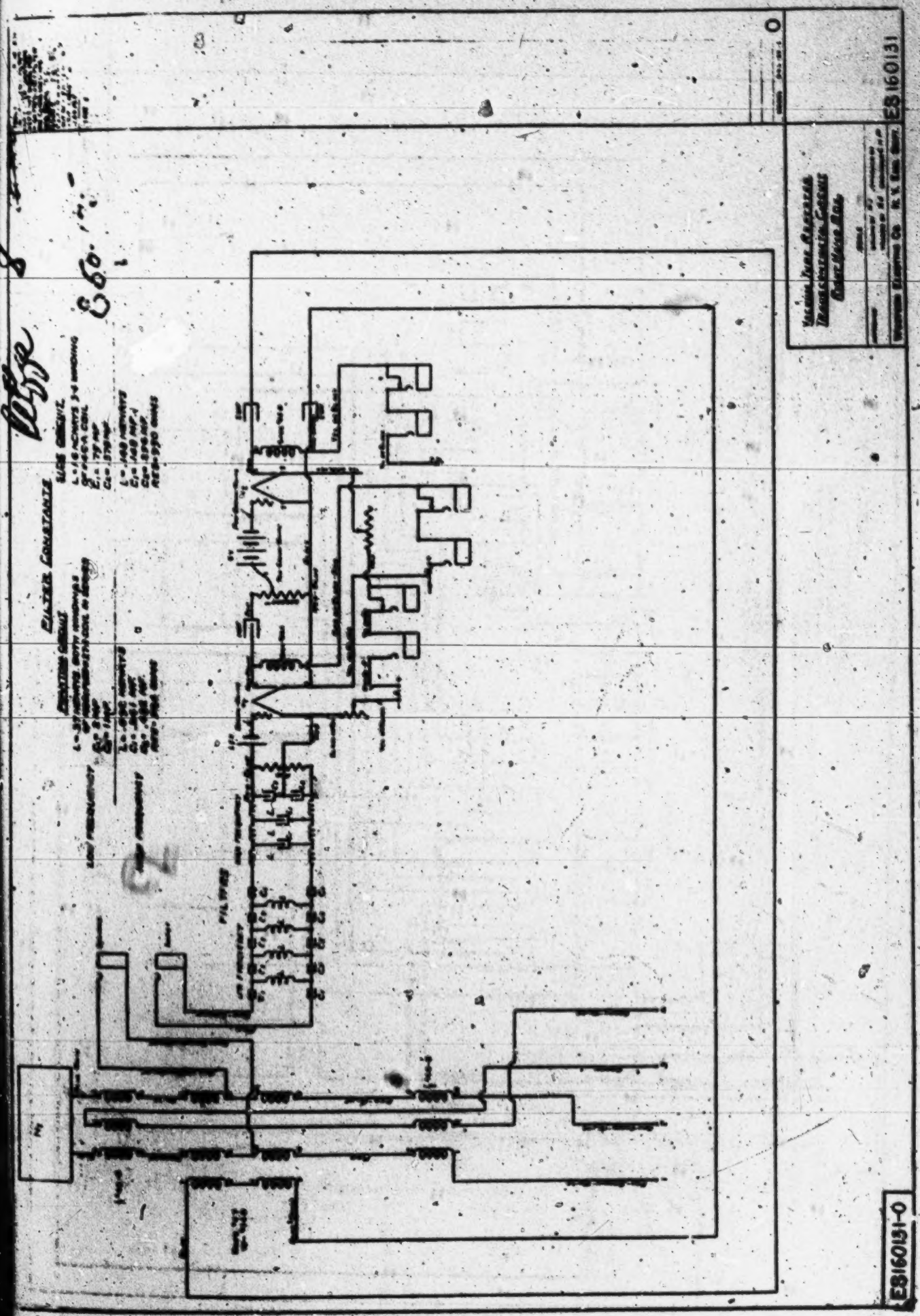

THE RADIO SPECTRUM
KILOCYCLES
10
100
195
945
285
390
485
550
1,500
1,600
1,700
2,000
2,200
2,500
2,750
3,100
3,500
4,000
4,535
5,365
6,140
6,425
7,205
8,500
8,810
11,000
13,300
14,350
16,000
18,100
21,420
23,000
30,000
60,000
FIXED POINT TO POINT LONG WAVE, TRANS-OCEANIC, HIGH POWER SHIP-TO-SHORE AND COMMERCIAL
FIXED POINT TO POINT AND MARITIME MOBILE SHIP TO SHORE
GOVERNMENT
GOVERNMENT AIR POINT TO POINT
GOVERNMENT
MARITIME MOBILE, AIRCRAFT, GOVT.
GOVERNMENT
BROADCASTING BAND
KFI - 640
WGN - 720
WJZ - 760
WBZ - 790
WLS - 870
KDKA - 980
KSTP - 1460
SHIP TO SHORE
AIR, ETC.
AMATEUR
TELEVISION
POLICE, FIRE, ETC.
SHIP, AIR, TELEVISION
TELEV., FOREIGN GOVT.
FOREIGN, AIR, ETC.
AMATEUR
SHIP, GOVT., FOREIGN
POINT TO POINT FOREIGN, ETC.
FOREIGN AIR, GOVT., ETC.
RELAY, BROADCAST, AIR
SHIP - POINT TO POINT
AMATEUR
GOVT., SHIP TO SHORE
PT. TO PT. - RELAY BCST.
POINT TO POINT
POINT TO POINT GOVERNMENT, SHIP
POINT TO POINT AMATEUR
POINT TO POINT
AERO, GOVERNMENT, POINT TO POINT, MISC.
POINT TO POINT
POINT TO POINT, SHIP, ETC.
EXPERIMENTAL, AMATEUR
EXPERIMENTAL AND AMATEUR
30,000
10
5
METERS - WAVE LENGTH
3,000
1,000
300
200
150
100
WEAF (WJAR) 492 M.
WBZ (WBZA) 333 M.
WEEI (CFCY) 440 M.
WJZ (WBAL) 405 M.
WSAI 361 M.
WSB 428 M.
WBAP 476 M.
WOAI 395 M.
WEAR 508 M.
WTAM 389 M.
WCAE 462 M.
WWJ 353 M.
WGY 380 M.
WHAS 400 M.
WSM 282 M.
WMC 499 M.
WSMB 319 M.
WFAA 475 M.
WOC 484 M.
WHO 526 M.
WOW 526 M.
WDAF 365 M.
KSD 546 M.
WRVA 256 M.
WBAL 422 M.
WIP 509 M.
WCSH 462 M.
WGR 319 M.
WKRC 423 M.
WSAI 361 M.
WLW 422 M.
WSPD 517 M.
WJR 441 M.
WCCO 416 M.
WDAY 384 M.
KSTP 454 M.
WEBC 468 M.
KOA 509 M.
KGO 361 M.
KFI 467 M.
KPO 423 M.
KFOA 455 M.
KGW 492 M.
KOMO 455 M.
KHQ 509 M.
KGA 484 M.
KFRC 423 M.
KFSD 499 M.
KTAR 423 M.
KOB 349 M.
KTHS 470 M.
KVOO 429 M.
KTBS 441 M.
KPRC 296 M.
WOAI 395 M.
WBAP 476 M.
KLZ 322 M.
KOIN 319

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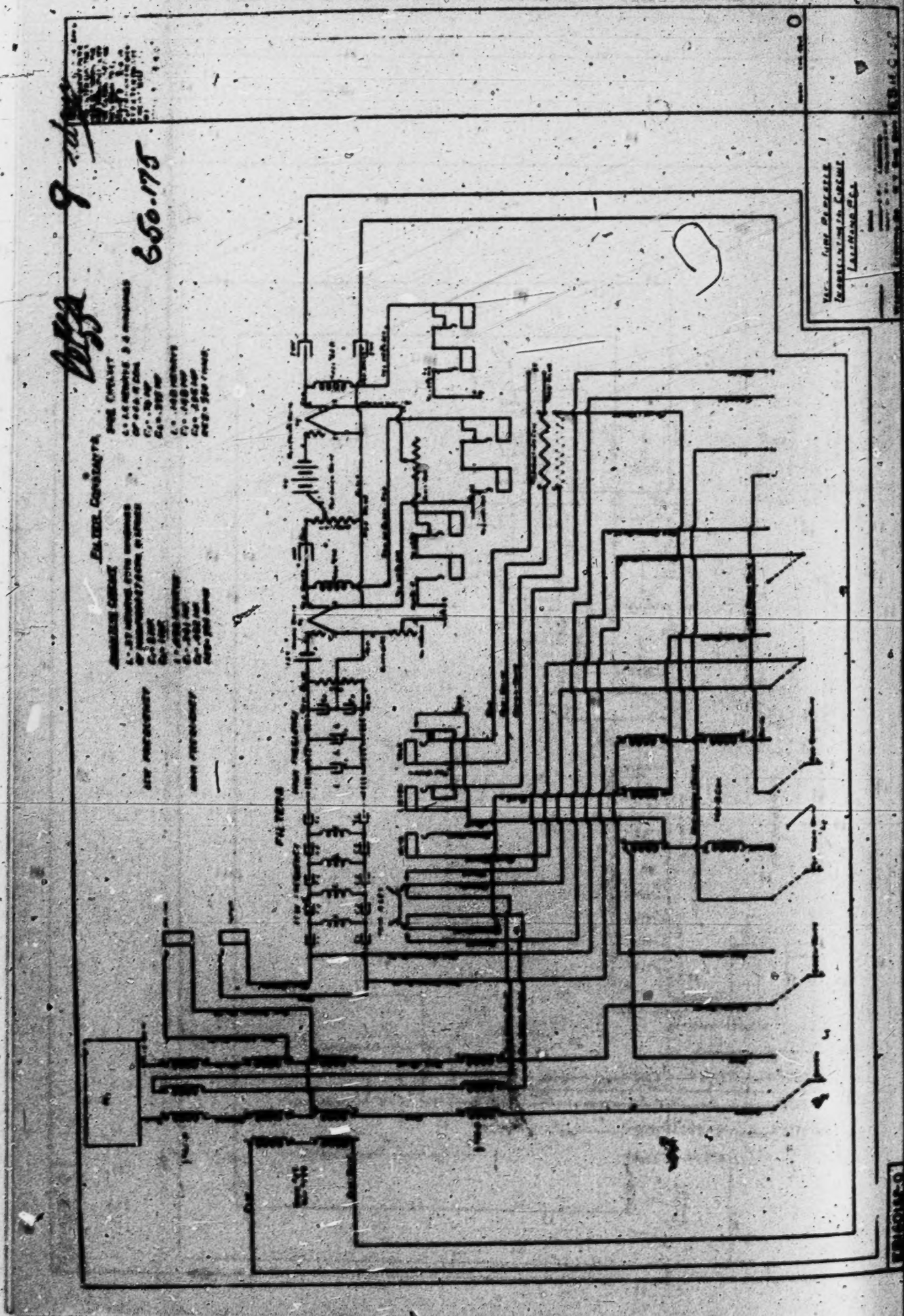
PLAINTIFF S'. EXHIBIT No. 8

Tracing ES160,131, dated December 8, 1914, entitled "Vacuum Tube Repeater Transcontinental Circuit.



PLAINTIFF S' EXHIBIT No. 9

Tracing ES160,132 dated December 8, 1914, entitled "Vacuum Tube Repeater Transcontinental Circuit"



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PLAINTIFF'S EXHIBIT No. 9

SAN FRANCISCO Call BULLETIN
JAN. 25, 1915

Jan-25-1915

E 50-175

INFORMATION DEPT
OFFICE COPY.

INVENTOR CELEBRATES TRIUMPH

Mayor Rolph of San Francisco and Mayor Mitchel of New York in Chat.

Officially and formally, San Francisco telephoned to New York today.

History was made when Mayor Rolph, sitting at a decorated table on the inland floor in the offices of the Pacific Telephone and Telegraph Company on Grant avenue and Bush street put the receiver of an ordinary-looking desk instrument to his ear and chatted with Mayor John Purroy Mitchel of New York, 3,750 miles away across the continent.

[illegible]

New York, and as one of the workers put it, "one foot of wire down knocks the whole system, and where's our ceremony then?"

But the rain—or perhaps it would be kinder to say the hundreds of visitors who were guarding the line from moisture—were favorable and the ceremony went off without a hitch.

[illegible]

In New York, apparently, the new apparatus caused as much as it did in San Francisco. The advantages to business men both ways, Rolph's successful wire conference officially proved the day. Long offices of the [illegible] system. The leaders did not [illegible] their private possession in advance and the situation was a series of surprises succeeding each the other.

Perhaps the most interesting feature was the conversation between Alexander Graham Bell, the veteran who invented the telephone, who was in the New York end, and Thomas A. Watson, who was his assistant and helped Bell in 1876, when the invention was made. Watson is now retired, having amassed a fortune of $5,000,000. Bell, who is [illegible] years old, has been [illegible] for many years. Watson, whose voice was recognized by Bell after [illegible] years, is [illegible] years old.

[illegible]

[illegible]

[illegible]

TRANS-CONTINENTAL LINE IS OPENED

Inventer and Builder of First Telephone Inaugurate Service Between Eastern and Western Metropolises

CHRONOLOGICAL DEVELOPMENT OF THE LONG DISTANCE TELEPHONE.

		miles
1876	Boston to Cambridge	2
1882	Boston to Providence	45
1884	New York to Boston	235
1892	New York to Chicago	900
1911	New York to Denver	2162
1914	New York to San Francisco	3595

Mayor James Rolph Jr. sat a one end of a telephone wire yesterday and Mayor John Purroy Mitchel sat at the other end. Mayor Rolph was in San Francisco, Mayor Mitchel was in New York. They exchanged greetings, and their voices were not blown away, the pitch used in ordinary conversation.

The talk of the two mayors oc-

electrical waves, swept across the continent at a velocity of 56,000 miles a second, without tumbling over upon other or crowding each other's path, passed through noisy cities, crossed roaring rivers and snow-capped mountains, with their rate of speed faithfully preserved and conserved until, converted back into sound waves, they agitated the air in San Francisco precisely as they had done in New York.

"Ahoy! Ahoy! can you hear me?" said Dr. Bell in New York. "I can hear perfectly" answered Mr. Watson.

When the telephone had grown to that it could be talked vaudeville on October 9, 1876, Dr. Bell first called "Ahoy" across two miles of wire, just as he was calling now, forty years later, across three thousand four hundred miles.

And as completely has the telephone annihilated space that is less than one-thousandth of a second, Mr. Bell's ear caught the reply, although it let many hours pass to cover it had passed through the



THOMAS A. WATSON,
Bell's Associate

cooled and strung in the Boston station, were installed for this celebration at either end of the transcontinental line. And the instrument into which Dr. Bell talked was a replica of the first telephone, just a drum-head of animal fibre over a wooden receiver, the center of the drum-head joined to the free end of a receiver spring and a simple mouth-piece adjusted to the drum-head. And despite the blackness of the first crude instrument and the antiquated wire, the modern volume of talk, many words a minute, like Bell to speak into the first crude instrument and send his voice across thirteen states.

With the ceremonial in the operating room of the sixth floor of the Chest events building of the telephone company overlook the successful culmination of the transcontinental line to the Atlantic was public, it will not be ready for commercial use for many days, as there is much work yet to be done, and as a rule is not ready to call at the beginning. But the simple cere-

after year the inhabitations will pile up. The completion of the great transcontinental line marks the beginning, not the end, of telephone expansion. Before Vail's dream is fully realized it will be possible for anyone anywhere in the United States to talk to any one else anywhere in the United States.

It was 1 o'clock San Francisco time and 4 o'clock New York time when President McFarland of the Pacific Company seated himself at a table in the specially decorated

offices on the sixth floor of the Pacific Telephone and Telegraph Company's building in Grant Avenue and took up the receiver of the telephone. The guests who had been invited to be present at the significant ceremony, including state and city officials, representatives of civic bodies, telephone officials, scientists, engineers and newspaper men, were all attention.

"Hello, New York, hello, yes, I hear you," said Mr. McFarland. "Can you hear me?"

Then Mr. McFarland stood up and motioned to Mr. Watson. The line was tried. The sound waves were vibrating across the continent, and pulsating themselves into sounds in the San Francisco receiver.

It is fitting that the first conversation over the wires should be between Dr. Alexander Graham Bell, inventor of the telephone, and Thomas A. Watson, who made the first telephone and who first heard spoken words over a wire. Dr. Bell was in the office of the American Telephone & Telegraph Co., at 15 Dey St. New York while Mr. Watson was on the sixth floor of the Grant Ave. building in San Francisco.

After Mr. Watson had ended his talk with Dr. Bell the mayor of the Western metropolis exchanged greetings with the mayor of the Eastern Metropolis.

Among those present as guests of The Pacific Telephone and Telegraph Company in the Telephone building at San Francisco to witness the celebration of the opening of the transcontinental line were Judge W. W. Morrow, Mayor James Rolph Jr., Wm. H. Crocker, H. D. Pillsbury, R. T. Peale, Wm. Sproule, R. P. Schwerin, J. A. Britton, S. P. Eastman, F. H. Leggett, P. E. Anderson, H. T. De Young, Wm. Woodward, Wm. Meyer, R. B. Hale, D. E. Skidmore, Maj. Adolphus Wetter-

SAN FRANCISCO CHRONICLE.

WEDNESDAY, JANUARY 27, 1915

A TELEPHONE TRIUMPH.

Long Distance Line Installed Between the Atlantic and Pacific.

SAN FRANCISCO can now call up or be called by New York or Boston over the telephone. For 3635 miles the human voice can carry over the wires as distinctly as though it were being borne by the same medium to the next stage. Bell, the inventor, and Watson, the maker of the first instrument, greeted each other across the continent with the chimaera which marked their exchanges over a two-mile wire thirty-nine years ago, when the telephone was first tested. The President spoke his good wishes to the city, and The Chronicle received and replied to congratulations by voice from Atlantic Coast correspondents.

It is a scientific achievement, but those who may be disposed to regard it as that only should be reminded of the commercial questions with which the first telephone was received. For inside the question however the scientific to which the instrument would be put. Even Bell and his enthusiastic associates showed an underestimate of a single Nation building about the million telephones.

The men who have put their capital into this transcontinental line must be as shrewd as they are enterprising. They have calculated the demand for economic communication, as well as possible competition from other device. Knowing that the limit of the wire line telephone is 600 miles, they are perfectly satisfied with a circuit with a capacity of 3000 miles.

It will be no less for fabulous gossip, but it should be in paying demand for urgent commercial, financial and other communication.

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PLAINTIFF 8' EXHIBIT No. 13

Page 88 of Kendall's Note book No. 26

Found it made no diff. if killed anderson when output clet. to bridge across input 88
3 13 open both ways. 3 14 only with other one killed

decided to go to N.Y. took all anderson except 253, 257, 272.

More information regarding loading on P-CWD. near Marion - Marion is practically at a loading point.
also Path 8-12, 19-20, 27-28, loaded west of T.P. and 5-6 loaded east of T.P. in Marion Cat. station
Marion is about 2/3 dist from here to Chi.
139 miles from Chi - Chi is 535 from Pgh.
Marion loop = 692 mm.
Pairs 13/16 loaded 2 poles west of Marion station
Marion is evidently a good point to loop -
5/6 to any of those whose loading is west of Marion T.P.

Pgh. 9/10 9/14. Carried, to put in 8th B anderson, with higher B current, - calls in Cabt, high fast resistance across high side of input to adjusting gain by tapping R part of this for the grid. Checked high res. coils - all about 6 000 Ω each. Shunted micro ammeter.

Readings

Instrument	~~9.85 mA = 196 mA.~~			
Remove shunt	10 x 10 = 100 mA.	57.8	50	100
new shunt.	20 x 5 = 100 mA.	200	175	340
I. dir =	25.1 mA.	28.6	28.5	29.4

Ratio 600 950 929
200 250 333
Ratio is 1:3 48. 1 div = 30 mA.
Full scale = 3 miles
Earlier readings - some thermal effect due to recent soldering.

Test of some anderson - with 6° calls - I_0 = 2 mils
I_y = 1.7°
Ri = output transformer annually connected - both sides in series

Ends	R.	Jam.	#	R.	Jam.
398	250 mm	10	396	250 mm	9
	150 mm	9		200	7
	100 mm	4		150	5
	50 mm	6		100	2
				125	4
				175	7

with output transformer changed to have high side in H.

394	150 mm	4	396	200 mm	6.
	200	7		250	10.
	250	9		225	9.
	225	10		175	6

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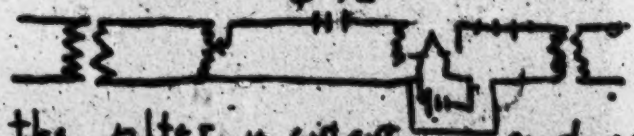
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Page from Notebook No. 42

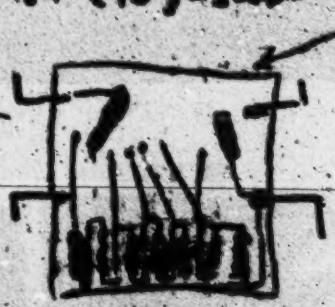
MARCH 23 1914

MONDAY

E^{32} #9 on Audion circuit.
This is the first day of tests of new audion and modified audion circuit.



Also the filter is cut out and resonate circuit taps for ringer set placed on "repeater" contacts instead of on bridge contacts as formerly. – (Ringer taps put through O.K.) and 6. C. cells are used instead of 2 and their polarity reversed (– on gnd)
Audion 400 operate to Balto
" 399 " N.Y.
400 – 1.6 – 6 (7 v.cu) – 73 (16") – 2000 – R=2
399 – 1.6 – 6 (7 v.cu) – 84 (92") – 1000 – R 2



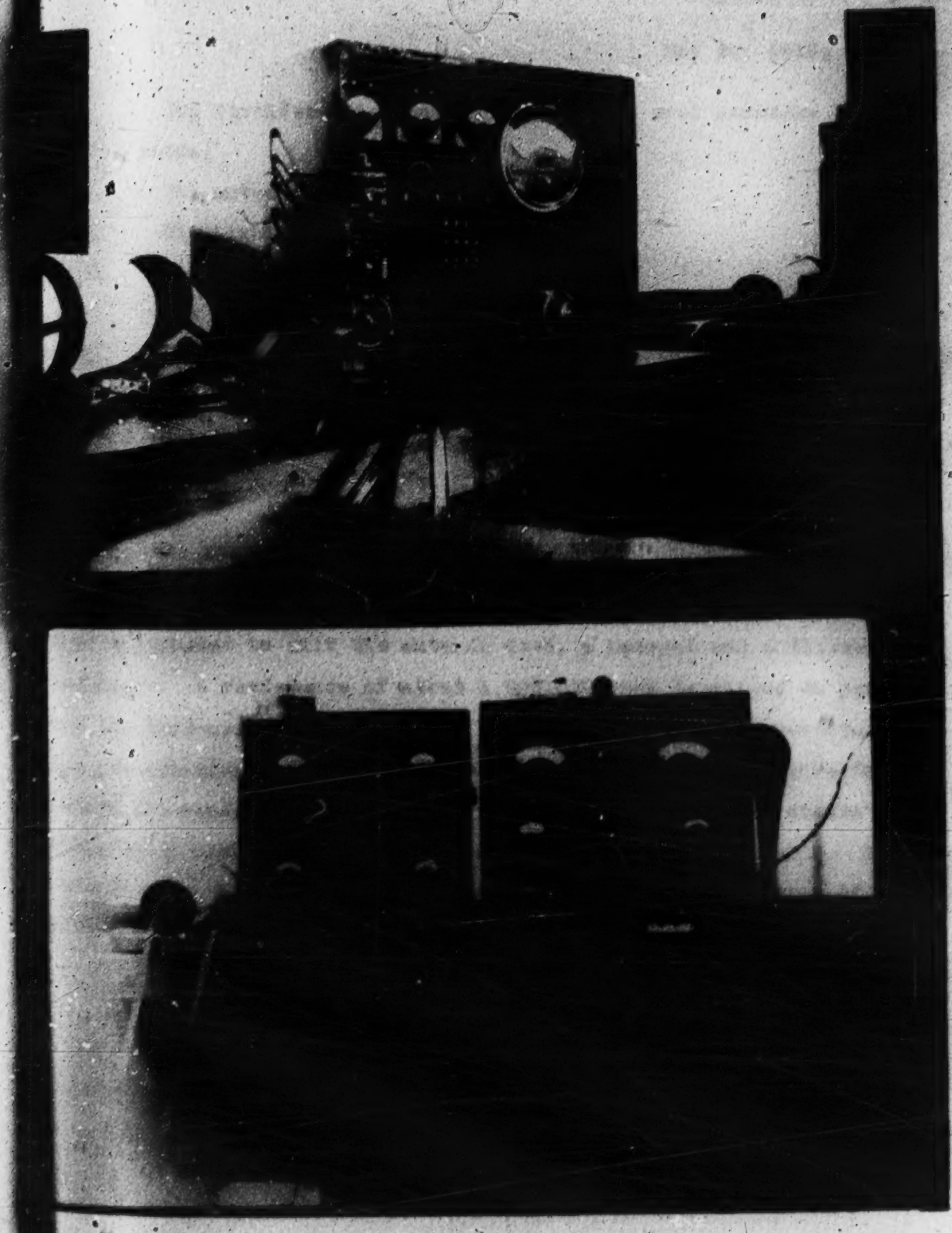
9[2] Two cells put in
Quality seems all that
could be desired, no
trouble to hear,
very metallic current all
about a two percent
decrease in space currents during transmission, wire
noticeable in audion 399 than in 400
9[22] Conversation on business topics finished, 1 up 1 d
9[24] Spring 4126 – Parker at Salt Ball
9[25] Operator repeats 3 am, several times
9[32] Baltimore talks – no trouble to hear
10 – Man and lady talk, about 5 m
conversation
10[22] No talk
Line is available while the two
calls put
10[27] 400 – 1402 – 399 – 1960
10[32] Two men talk – O.K.
11[2] N.Y again talks with Washington.
11[27] O long N.Y Ball transmission O.K.
11[33] Two men talk with Wilmington O.K.

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PLAINTIFF'S EXHIBIT No. 18

Photograph of the radio receiving set used in the 1918 Radio Telephone Tests



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PLAINTIFF'S EXHIBIT No. 17 663

Wilson memorandum and drawings relating to the 1915 Radio Telephone receivers

#1

Coil D 1233

May 26, 1915.

E-50-176

The Wireless Telephone Receiver to be used consists briefly of five parts:

(1) The antenna circuit

(2) The high frequency amplifier

(3) The rectifier

(4) The low frequency amplifier

(5) The stopper

The arrangement of apparatus is shown diagrammatically in Figure 1. Detailed drawings of the various parts are given separately.

1. The Antenna Circuit - (Figures 1 and 2)

The antenna is connected in series with a coil whose inductance is adjusted to suit the antenna used, a Marconi and a Klitzen condenser. A resistance of about 1,000,000 ohms is placed in parallel with the condensers. On account of its high value this resistance does not interfere with the passage of the high frequency currents through the condensers, and at the same time it allows any static charge which might tend to accumulate on them to flow to earth. The condensers may be joined either in series or parallel by means of the knife switches shown.

2. The High Frequency Amplifier - (Figures 1,2,3,4)

The coil "A" of the antenna circuit is loosely coupled with another coil "B" of about 25 M. H. inductance which forms part of an oscillatory circuit whose tuning is effected by means

of a Blitzen condenser.

The terminals of this condenser are connected to the input circuit of a vacuum tube repeater.

The vacuum tube repeater being essentially a device in which the output current is controlled by the input voltage, it is desirable to have its input internal resistance as large as possible.

Since the current in the tube is caused by the passage of electrons from the filament to the grid, the resistance may be made practically infinite by maintaining the grid at a negative potential with respect to the filament. This is accomplished by means of the $4\frac{1}{2}$ volt battery C.

The plate of the vacuum tube repeater is maintained at a potential of about 150 volts by means of the battery D. The batte is connected in series with a choke coil (44-B) and shunted by a 2 m. f. condenser which will allow the high frequency currents to pass.

The connections of the filament circuit are obvious from t figures.

Owing to electrostatic action between the plate and the grid the circuit is liable to sing. This is corrected by means of the small coil E which is connected in series with the output coil and provided with long leads so that it can be brought into the neighborhood of the coil B. The singing of vacuum tube repeaters is due to the mutual influence of the grid and plate circuits. By properly adjusting the coupling of coils E and B, the magnetic induction can be made equal and opposite to the electrostatic and

hence the singing may be stopped.

The output from the vacuum tube repeater is fed into a second oscillatory circuit "T" and the external output impedance and hence the energy output may be varied by adjusting the coupling between this circuit and the output coil.

A switch is provided and is shown in detail in Figure 3 by means of which the antenna may be connected through the first tuned circuit directly to the rectifier.

3. The rectifier

The transmission of speech is accomplished by the variation of the amplitude of a high frequency wave. This is represented diagrammatically in Figure 5. The high frequency oscillations are produced by the generator and the envelope of the waves represents the voice vibrations.

Before these vibrations can be made audible at the receiving end it is necessary to modify the waves again so that a telephone receiver can translate them into speech sounds.

On account of its high impedance to waves of high frequency the telephone receiver will not transmit the short waves, and further any ordinary telephone diaphragm would refuse to respond to such high frequency waves on account of its inertia.

If however, the modulated wave is rectified only half of the wave will be left and since the high frequency oscillations are much too fast for the receiver diaphragm to follow, this latter will follow a path dependent only on the amplitude of the oscillations, i.e. will vibrate in a manner corresponding to the speech vibrations.

The amplified high frequency current is therefore next sent through a rectifier which consists of a high impedance vacuum tube repeater. The terminals of the condenser in the circuit "F" are connected to the input of this tube, one terminal being connected to the filament and the other through a Marconi condenser to the grid. The use of the condenser is explained below.

The connections of the plate circuit are obvious from the diagram. The introduction of the 2 m. f. condenser is as before to save the high frequency from the necessity of passing through the battery. The 43-A choking coil is inserted to prevent inconstancy of working due to local troubles in the batteries and to make possible the use of a common "B" battery for the two tubes.

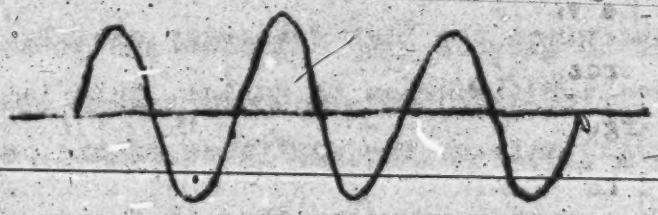
The action of the rectifier may be best understood from a consideration of the D. C. characteristics.

The connection between output current and input voltage for a vacuum tube repeater is shown in Figure 6.

Now consider an arrangement of apparatus such as that shown in Figure 7, i.e. without the condenser used in practice.

Let the applied A. C. voltage oscillate between the extreme equal values O L and O M. Owing to the curvature of the characteristic the increase of current due to the increase of voltage to O L will be greater than the decrease due to the decrease O M.

Hence an input which is quite symmetrical such as



will come out as a distorted wave such as:



Since the current in one direction during one half of the cycle is greater than the current in the opposite direction during the other half there will be a D. C. component which is proportional to the amplitude of vibration and hence in the case of the rectified high frequency these currents follow the contour of the envelope.

Now consider the circuit shown in Figure 8 where a condenser shunted by a high resistance is placed in series with the grid.

If the A. C. were not applied the current would have a definite value represented by O N, Figure 6.

This would be constant with respect to the time and is represented by ab, Figure, 9.

On application of the A. C. the grid voltage rises to an amount O L with the first vibration. This tends to increase the space current but owing to the fact that the current through the tube is caused by electrons, the charge on the grid is immediately neutralised and the current does not rise much above its original value. This neutralisation of the positive charge leaves then a certain amount of negative electricity in the grid connections. When the A. C. swings to the value O. M. a certain amount of negative electricity will be forced on to the grid, and this together with the negative charge left there will bring the grid to a lower potential than it would have had if the condenser had not been in the circuit. This will cause the output current to decrease considerably since the negative electricity cannot be neutralised by the electron

stream. The output current will therefore be as shown by bc, Figure 9. The dotted line represents the average current.

When the A. C. is cut off the current will not immediately return to its original value unless some means is adopted to get rid of the residual negative charge in the grid connection. This is done by shunting the condenser with a very high xylol resistance. This resistance charge to remain while the high frequency oscillations are taking place, but to allow the residual charge to leak away as soon as the oscillations stop.

If then a train of waves strikes the detector, it gives rise to a rectified current which is proportional to the amplitude of the waves. If the amplitude changes, the current follows the change in amplitude.

In the case of the transmission of speech, the amplitude of the waves follows the vibration of the voice and hence the D. C. current obtained follows the speech vibrations.

The output is sent through an amplifying set which increases the intensity of the rectified current. Since the amplifying set is essentially a device in which the output current is controlled by the input voltage it is essential to have this latter as large as possible. This is accomplished by sending the output current of the rectifier through a high impedance 500,000 ohms. In this way the total available power from the rectifier is not used but the maximum voltage output is obtained.

4. The Low Frequency Amplifier - (Figures 1,10,11,12).

The output from the rectifier is connected to the input of the

of the low frequency amplifier set. This consists of two vacuum tube repeaters in series whose action is similar to that of the high frequency amplifiers.

The output from the first vacuum tube repeater is passed through the low side of a 10 to 1 transformer "G" whose impedance is approximately that of the internal output resistance of the tube. The secondary of this is connected to the input of the second vacuum tube repeater and the output of this is led directly into the stopper. The input to the second vacuum tube repeater may be varied by means of the variable resistance "H".

By means of the double throw triple pole switch shown in Figure 10, either one or both vacuum tube repeaters may be used as required.

5. The Stopper - (Figures 1,13,14,15).

The stopper is a device for limiting the amount of telephone energy which is delivered to the telephone receiver. In wireless telephony irregularities are introduced by static discharges to the antenna. These are occasionally so large as to mask the signals completely. The stopper is so arranged that it will not allow signals of more than a certain intensity to pass through. The adjustment is made so that all signals louder than the speech signals will be cut off and hence the accidental noises cannot be louder than the speech signals.

A simplified drawing of the circuit is shown in Figure 1. The centre of a split inductance "J" is connected to the filaments of two vacuum tube repeaters. The ends of the inductance are connected to the grids. When an impulse comes along, it causes the potential of one of the grids to rise and that of the other to fall. This causes

669

a corresponding increase of current in the first audion and a decrease in the second. This in effect is the same as superposing a current on the normal output current as shown by the arrows.

The output circuits of the two vacuum tube repeaters consist as shown of a battery, high adjustable resistance X and two coils wound so as to have the same magnetic polarity when the superposed current flows through them.

Owing to the fact that the vacuum tube repeaters can only transmit current in one direction, it is impossible to do more by any impulse than to decrease the current in one vacuum tube repeater to zero. The current in the other tends to increase owing to the increase of potential on the grid.

On account of this rise of current the resistance of the tube decreases and since the output circuit contains a very high resistance, the voltage across the tube decreases. The circuit is so arranged by adjusting the resistance "X" that the fall of potential finally becomes so great as to prevent the rise of current above a certain amount.

If this amount is made approximately equal to the current required to transmit the talk, the interfering sounds due to accidental causes cannot possibly be of greater intensity than the speech.

By means of the triple pole double throw switch shown in Figure 13, the stopper can be thrown in or out of the circuit at will.

670

CIRCUIT SPECIFICATIONS

ITENNA CIRCUIT

Antenna inductance 6 to 25 M. H. according to stations.

Marconi Condenser.

Blitzen Condenser.

Shunt Resistance 1,000,000 ohms variable.

GH FREQUENCY AMPLIFIER

Type M Vacuum Tube Repeater

FILAMENT CIRCUIT	Storage battery 6 volts
	Rheostat 3 ohms.
	Current about 1.6 Amperes.
GRID CIRCUIT	Battery negative to grid $4\frac{1}{2}$ volts
	1 Ever Ready Tungsten Battery
Oscillatory circuit	Inductance 25 M. H.
	Blitzen Condenser
PLATE CIRCUIT	Battery about 150 volts.
	Choke Coil 44-B (10 henry)
	Shunt Condenser 2 M. F.
	Output coil 20 M. H. variable and
	Compensating Coil. Small inductance
	Current 8 to 10 milliamperes.

CTIFIER

High Vacuum Tube Repeater Type D

FILAMENT CIRCUIT	Storage battery 6 volts
	Rheostat 3 ohms.
	Current 1.6 Amperes.

672

GRID CIRCUIT

. Oscillatory circuit { Inductance 25 M. H.
Blitzen Condenser

Marconi Condenser

Xylol Resistance

PLATE CIRCUIT

Battery about 250 volts.

Choke Coil Special 43 A 100 H.

Shunt Condenser 2 M. F.

Resistance 400,000 ohms.

Current 300 Microamperes

LOW FREQUENCY AMPLIFIER
Two Type M Vacuum Tube Repeaters
First V. T. R.

FILAMENT CIRCUIT

Battery 6 volts

Rheostat 3 ohms.

Current 1.6 Amperes.

GRID CIRCUIT

Battery $4\frac{1}{2}$ volts negative to grid.

Resistance 800,000 ohms.

PLATE CIRCUIT

Battery 150 volts.

Choke Coil 44-B 10 H.

Shunt Condenser 2 M. F.

Primary of 10 to 1 voltage

Transformer W 187

Current 1.6 Amperes.

2nd Vacuum Tube Repeater

FILAMENT CIRCUIT

Battery 6 volts.
Rheostat 3 ohms.
Current 1.6 Amperes.

GRID CIRCUIT

Battery $4\frac{1}{2}$ volts negative to grid
Secondary of 10 to 1 voltage
transformer W 187.
Connected across 600,000 ohms
variable resistance.

PLATE CIRCUIT

Battery 150 volts.
Choke Coil 44-B 10 H.
Shunt Condenser 2 M. F.
Output across 44-B choke coil
and condenser fed into primary
10 to 1 voltage transformer W 187
Current 8 to 10 milliamperes.

STOPPER

Two similar Vacuum Tube Repeaters M Type

FILAMENT CIRCUIT

Storage battery 6 volts.
Rheostat 3 ohms.
Current 1.6 Amperes.

GRID CIRCUIT

Battery 9 volts negative to grid closed through secondary of 10 to 1 voltage transformer W 187 shunted by 600,000 ohms.

PLATE CIRCUIT

Battery 150 volts.

Choke Coil 44-B 10 H.

Shunt Condenser 2 M. F.

Variable Resistance 240,000 ohms.

Primary of output transformer.

Secondary of transformer through 1 m. f. condensers to telephone.

Connection between the various parts of the receiving apparatus are often made by condensers. These are shown in the sketches and their capacities are about 1 M. F.

TUNING ROUTINE

1. Tune the circuits to the frequency to be received by means of the auxiliary oscillator.

2. Adjust the high frequency amplifier and rectifier so that they do not sing.

   This may be accomplished by adjusting the coupling between the coils A and B (Figure 1). The direction of the current in the feed back coil may be reversed by means of the switch. Figure 4.

3. Alter the coupling so that the set sings and detune slightly.

   The beat note between the oscillations of the set and those of the sending should now be heard.

4. Tune the circuits until the pitch of the beat note is as low as possible.

   The most sensitive circuit is the first oscillatory circuit and the tuning should be made by successively varying that circuit and tuning the others.

   When the pitch of the beat note is lowest the circuits are most nearly in tune. Sometimes there is a range of tuning so low that the lowest beat tone is below the limit of audition. In such a case the center of the quiet zone should be chosen.

5. Vary the coupling of the feed back coil until the circuit does not sing.

The adjustment is not exact and the best reception is obtained when the coupling is as loose as possible consistent with no singing.

6. When these adjustments have been made the signals or speech of the sending station should be heard and the circuits tuned until they are loudest.

The external output impedance of the high frequency amplifier and hence the power output may be varied considerably by the coupling of the coils of the transformer F, Figure 1.

The coupling of these and of the coils A and B should be adjusted to produce the loudest signals.

The tuning is of course more selective the looser the coupling.

It is unnecessary then to strike a mean which will be determined by the working conditions between high selectivity and low intensity and high intensity and low selectivity.

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Pat. Ex. 17
Page 1
ES 160355

General Circuit Diagram of Wireless Receiver.

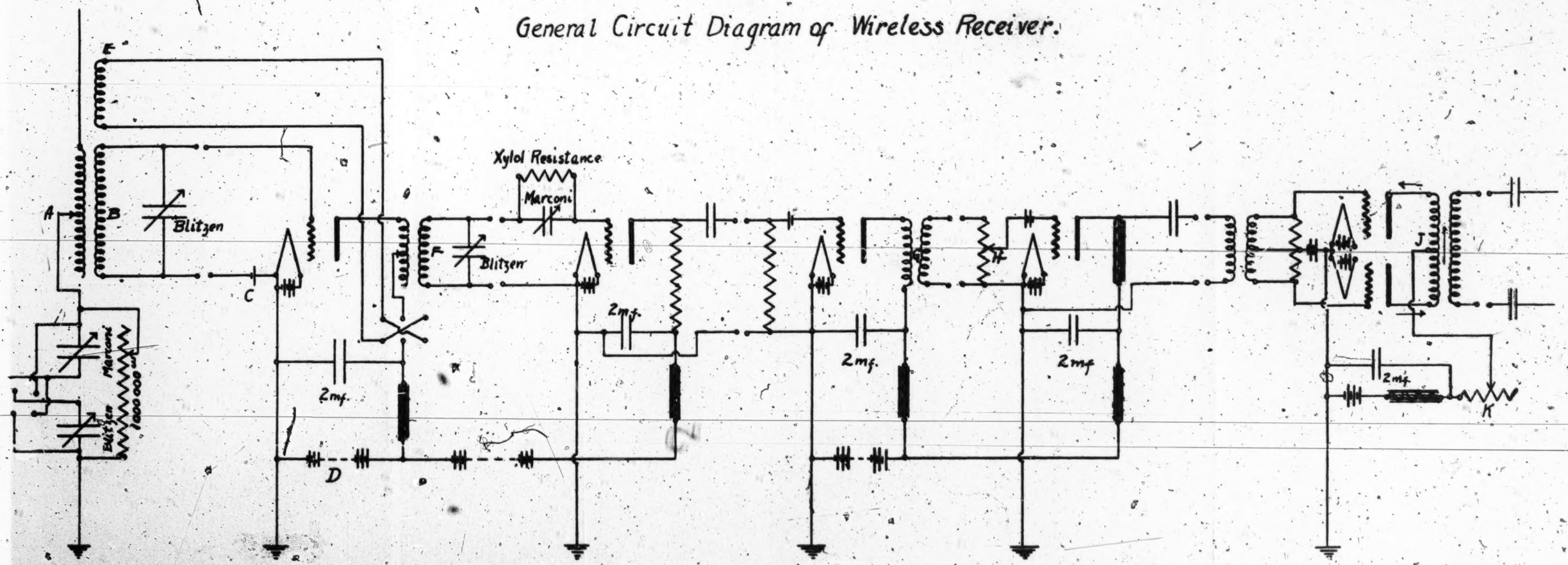


FIG. 1.

W. W.
Dft. 5-24-15

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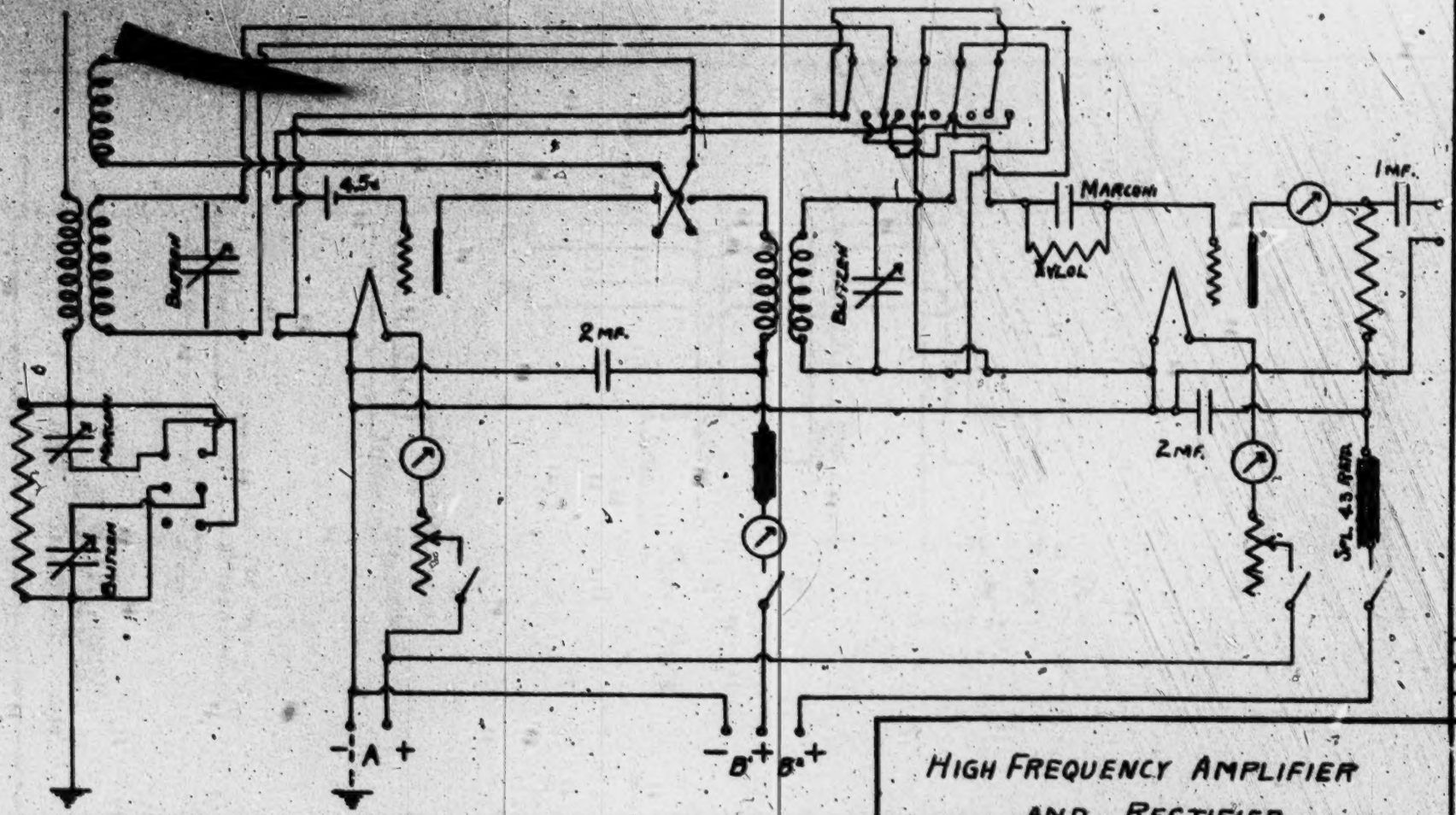


FIG. 2.

ISSUE 1 5-26-15	APP'D.
MODEL	DWG. ISSUE A

HIGH FREQUENCY AMPLIFIER AND RECTIFIER.

SCALE

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TRACED BY D.H.N. ENGINEER W. W.

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ES 160357

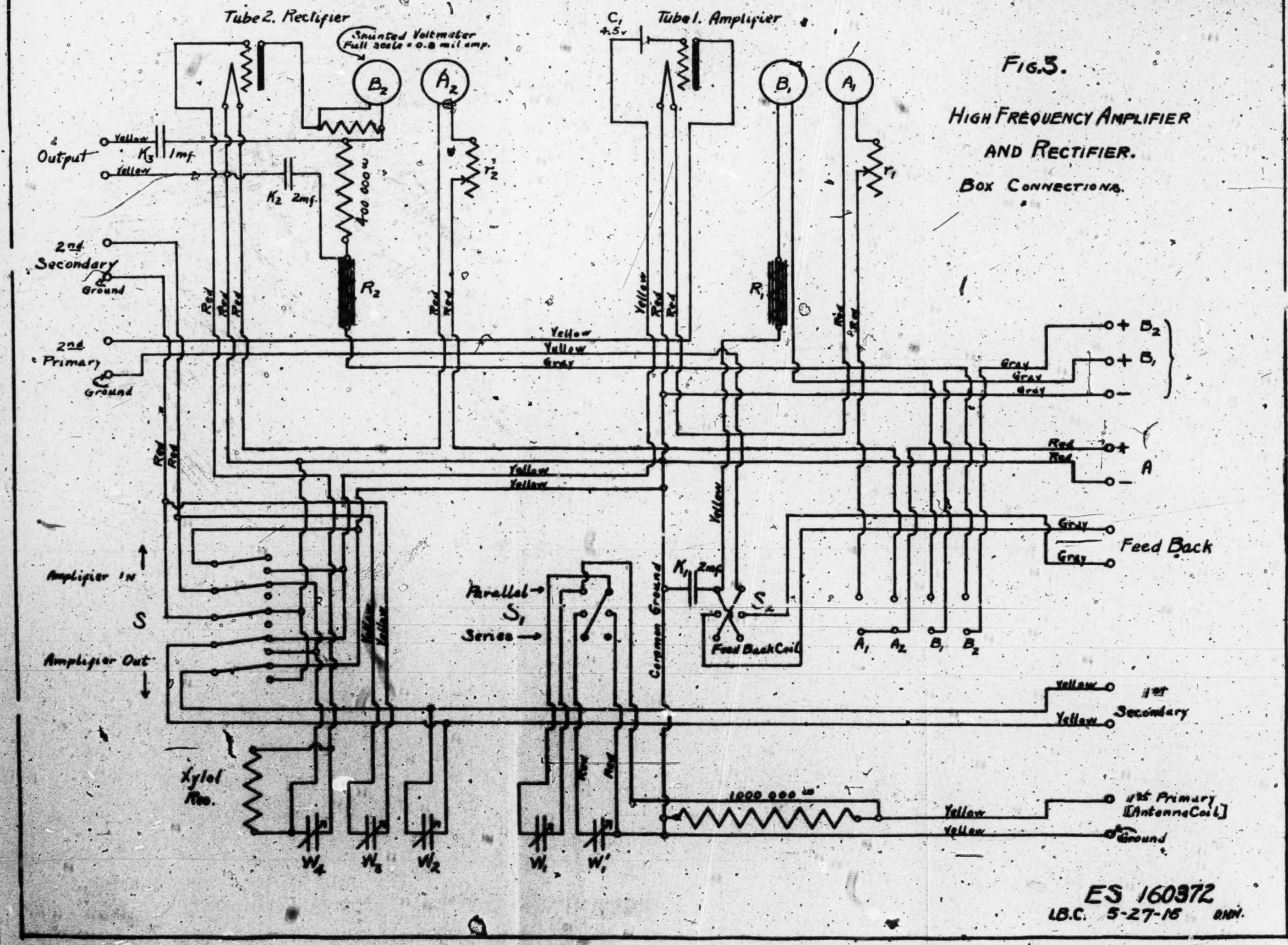
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PLTF. EX. 17 Page 17

FIG. 3.

HIGH FREQUENCY AMPLIFIER AND RECTIFIER.

BOX CONNECTIONS.



ES 160372

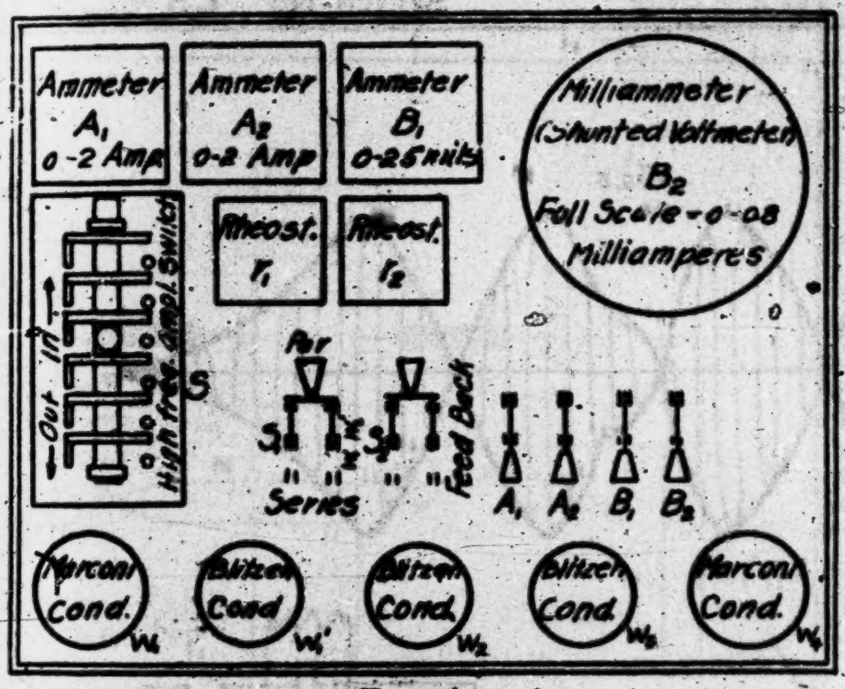
L.B.C. 5-27-16 DNN.

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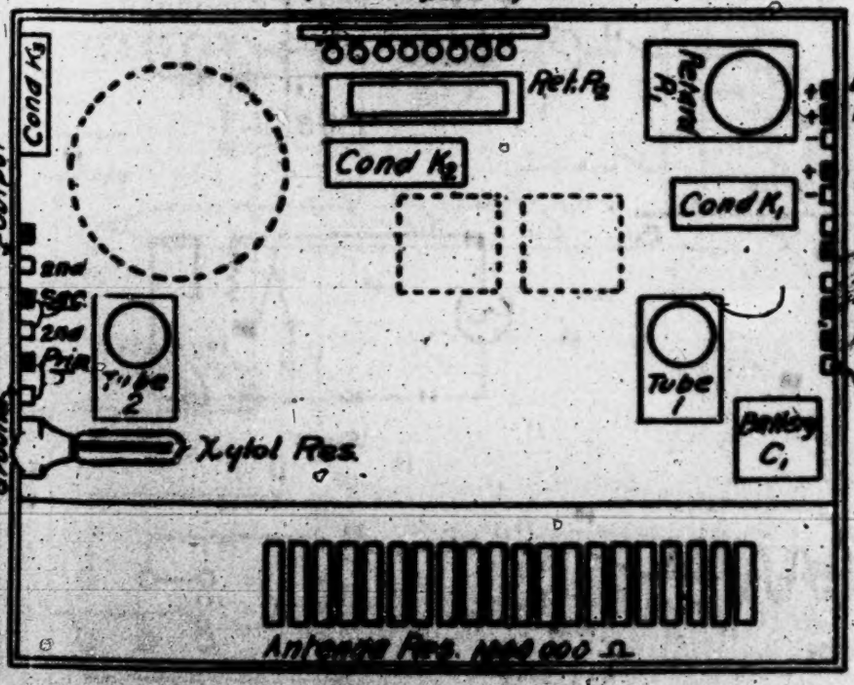
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SKETCH NO. ES/60373



Front

Output Res. Tube 2; 100000 Ω



Back

Fig 4
High-frequency Amplifier and Rectifier
Diagram of Box

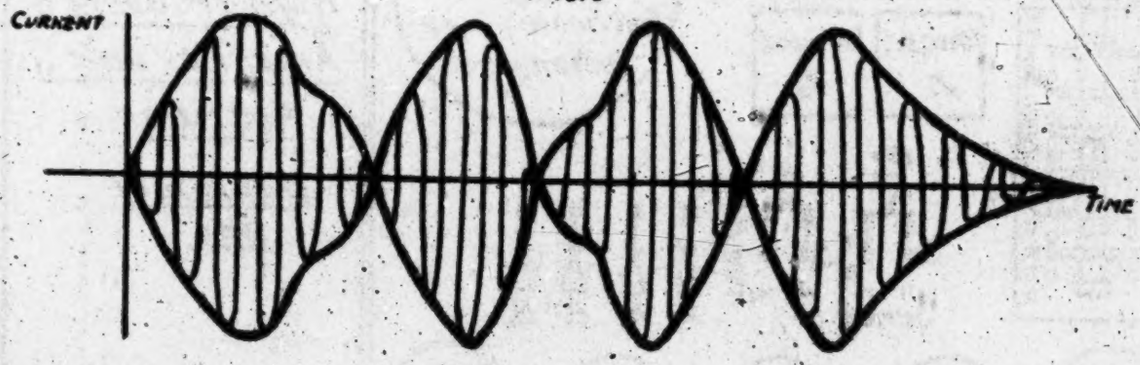
E.C.W. 5-27-15

Diagram: explaining circuit operation of 1 to 1 repeaters

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SKETCH NO ES 160354

FIG. 5



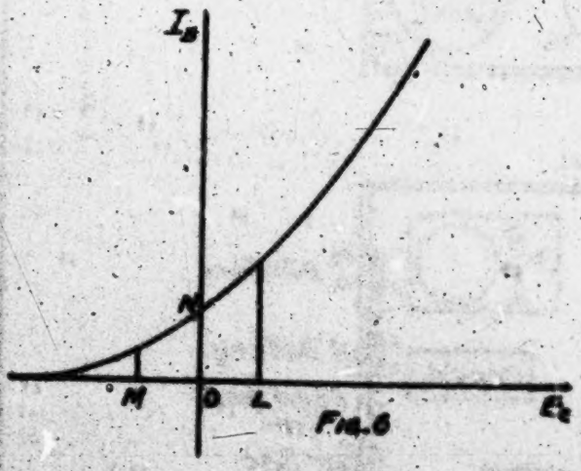


FIG. 6

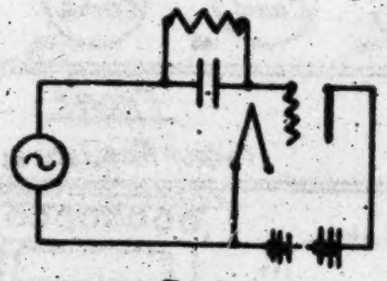


FIG 8.



FIG. 7

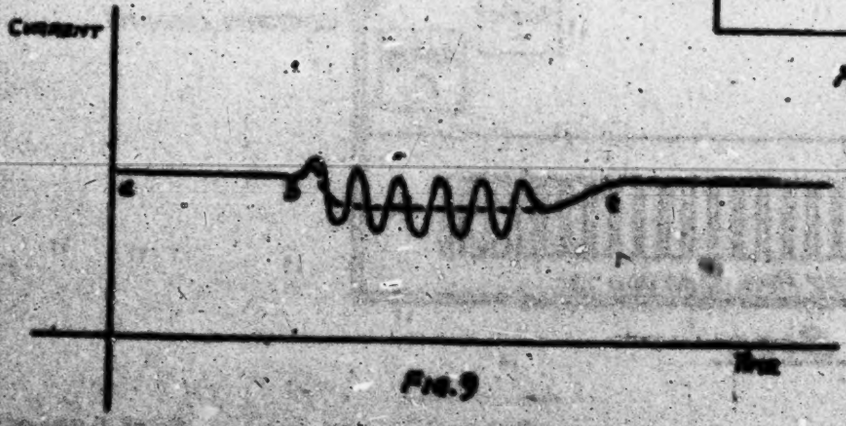


FIG. 9

11/19

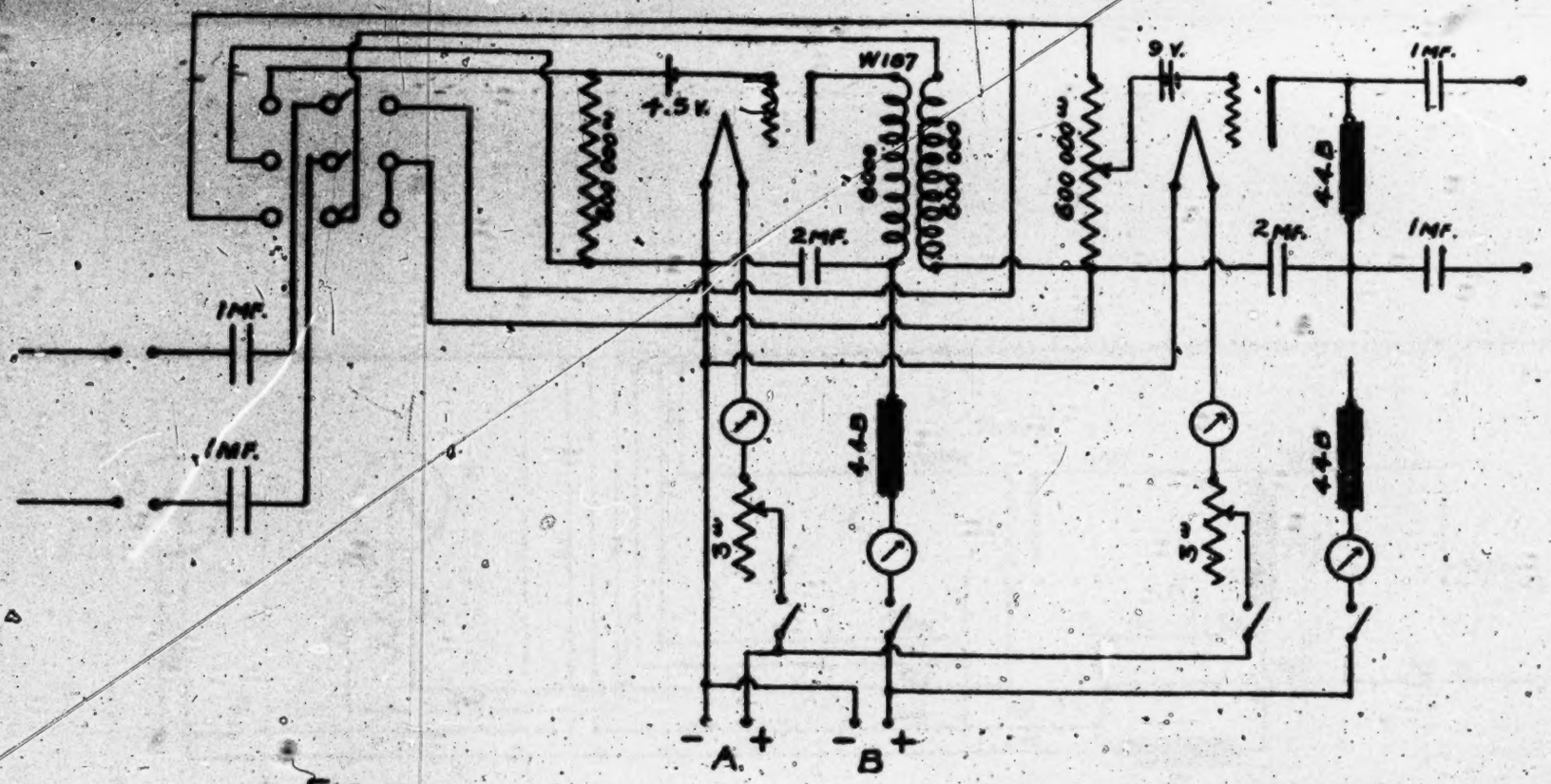


FIG. 10

ISSUE 1. 5-24-15 APP'D

MODEL	DWG ISSUE
	A

LOW FREQUENCY AMPLIFIER. [THEORETICAL]

SCALE

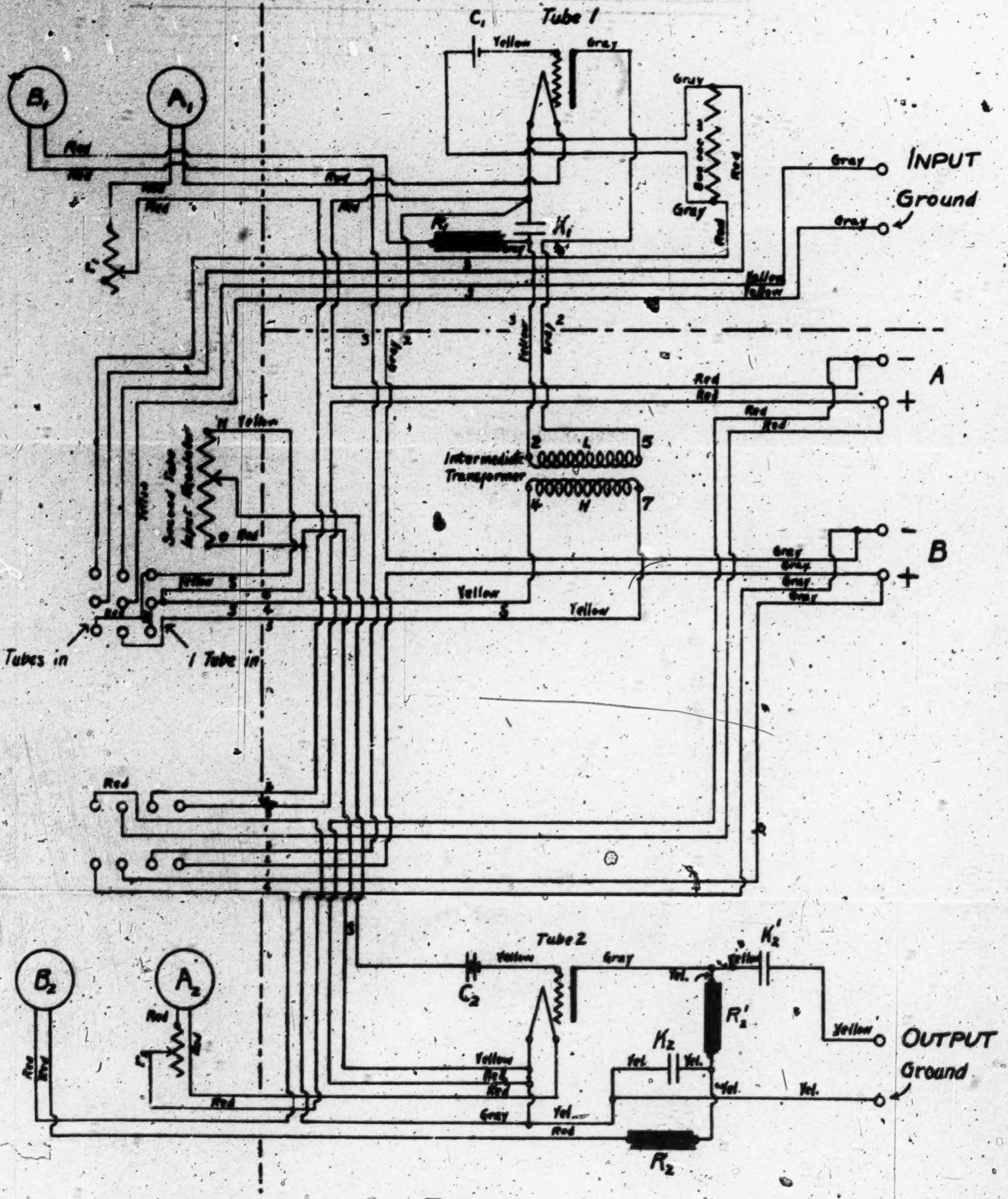
APPROVED

DRAWN BY D.H.N. CHECKED BY

TRACED BY D.H.N. ENGINEER W.W.

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ES 160356


Tube 1
Yellow
Gray
Gray
Gray
Gray
INPUT
Ground
Gray
Red
Red
Red
Red
Red
Red
Red
Red
Yellow
Yellow
Gray
Gray
Yellow
Yellow
Red
Red
Red
Red
Yellow
Intermediate Transformer
Yellow
Yellow
Yellow
Yellow
Gray
Gray
Gray
Gray
Red
Red
Red
Red
Red
2 Tubes in
1 Tube in
Tube 2
Yellow
Gray
Yellow
Yellow
Yellow
Yellow

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SKETCH NO. ES 160358

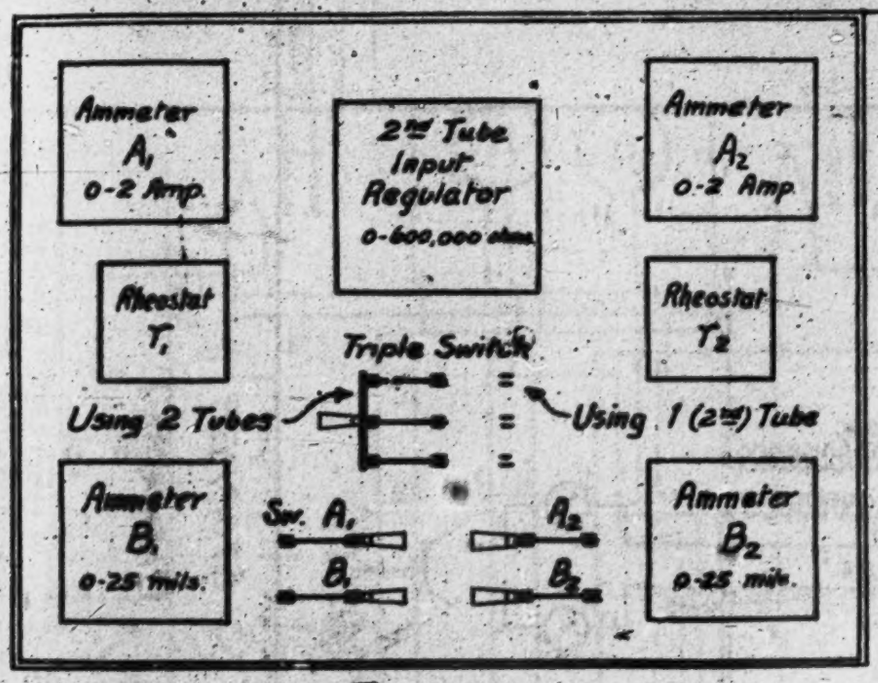
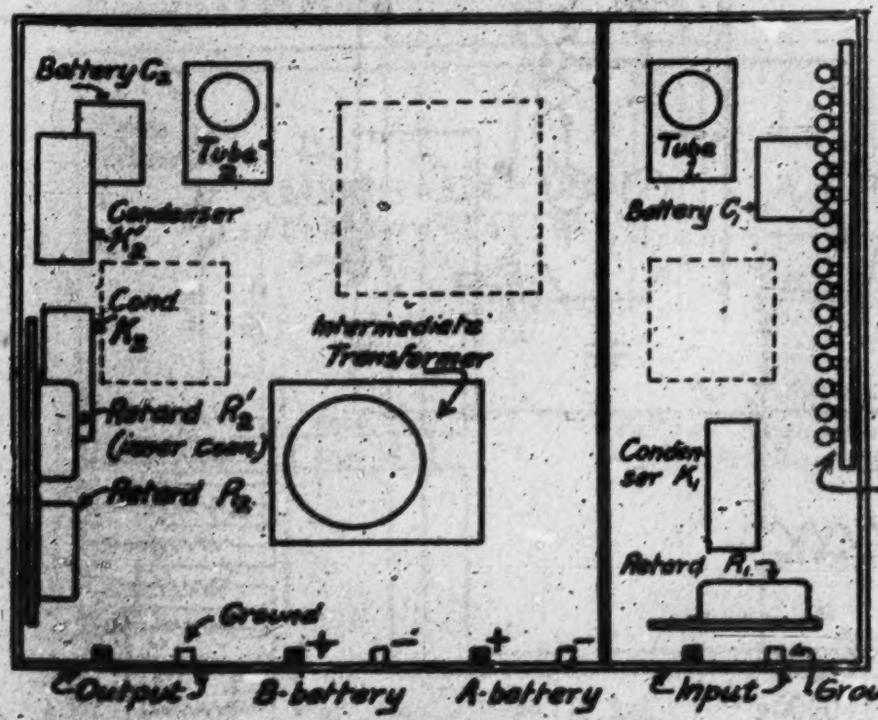


Fig. 12.
Low Frequency Amplifier.

Diagram of Box.

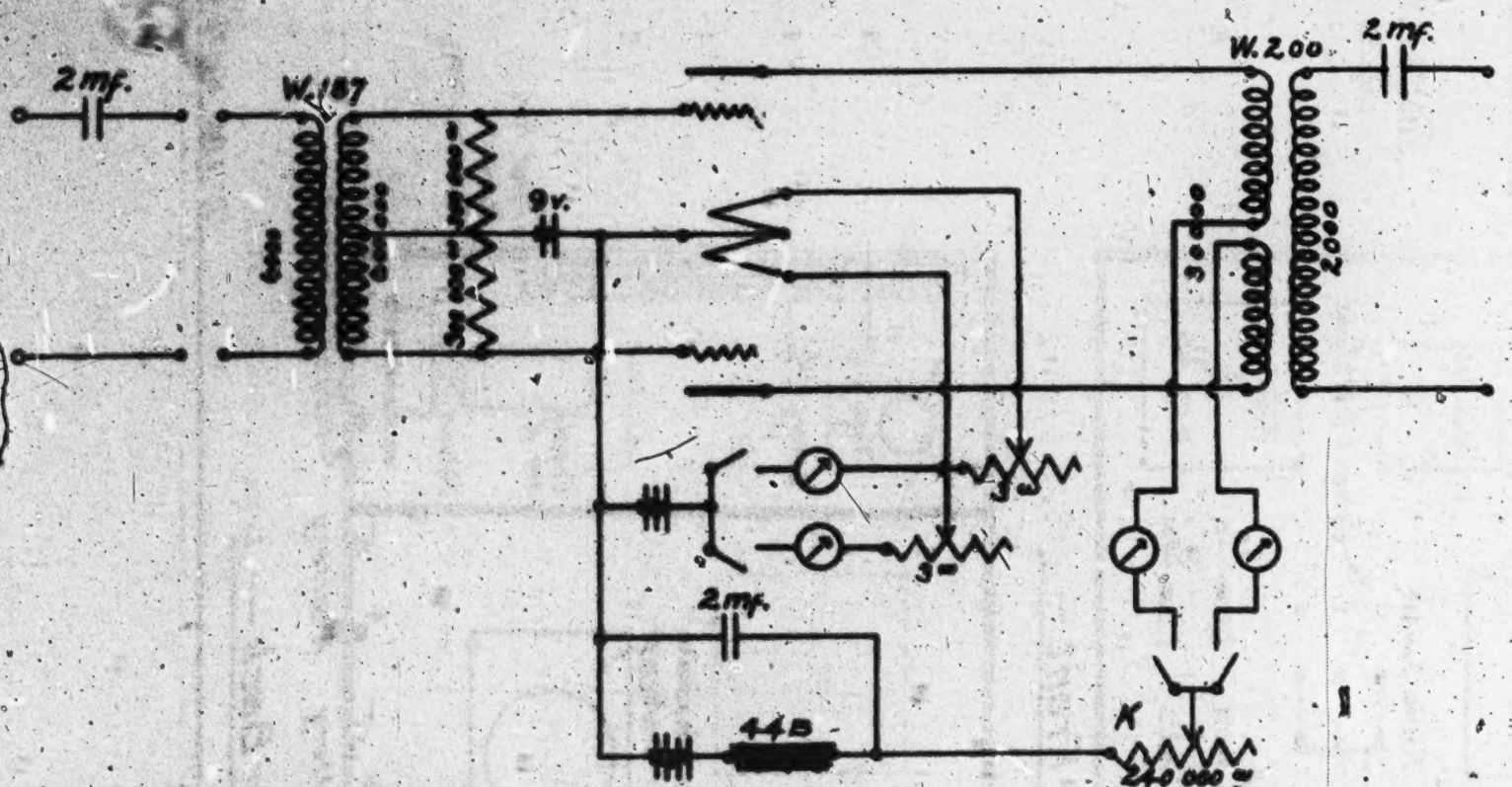
— Front. —



— Back. —

IBC. May 26-1915.

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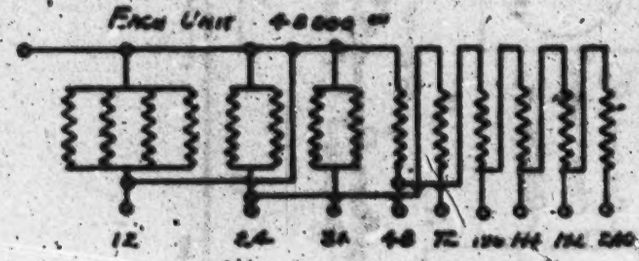


FIG. 13

ISSUE 1 - 5-27-15	APP'D.
MODEL -	DWG. ISSUE A

STOPPER

[THEORETICAL]

SCALE

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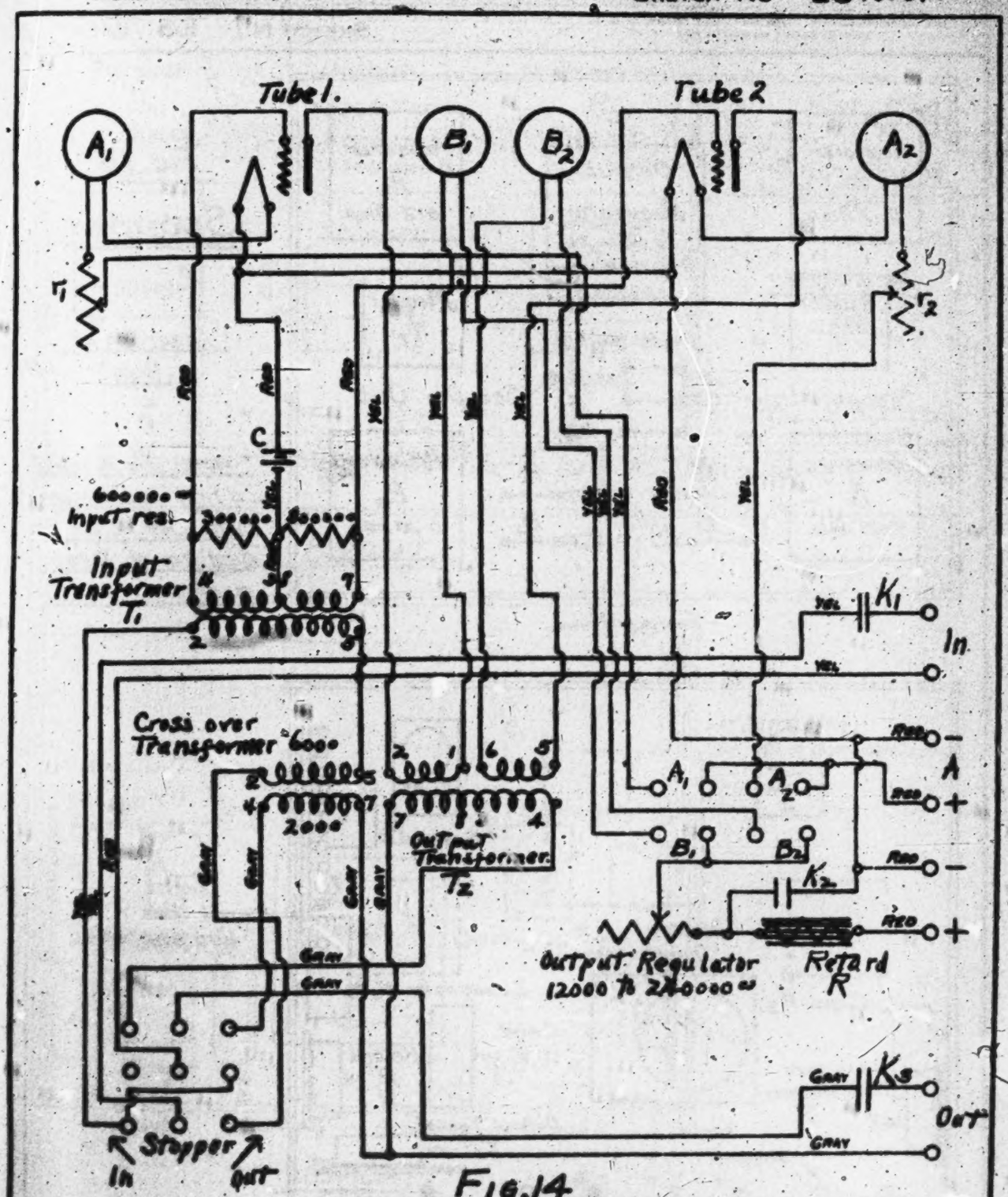
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SKETCH NO ES 160375



F16.14

Stopper ~ Box Connections

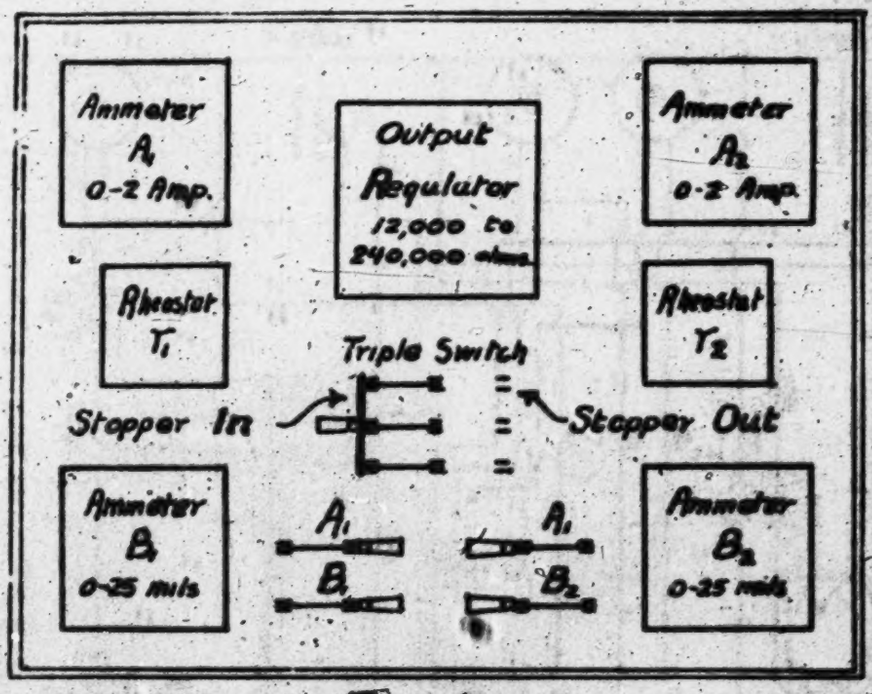
NOTE: "YEL" = YELLOW OR BLACK.

I.B.C. 5-27-15 WKH.

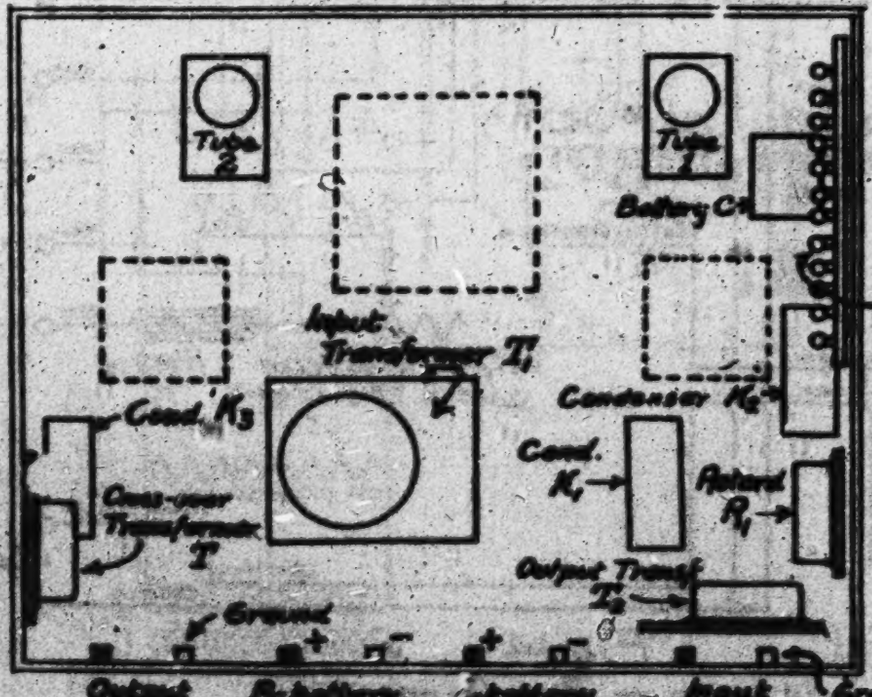
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SKETCH No. ES 160376



—Front.—



—Back—

Fig. 15
Stopper

Diagram of Box.

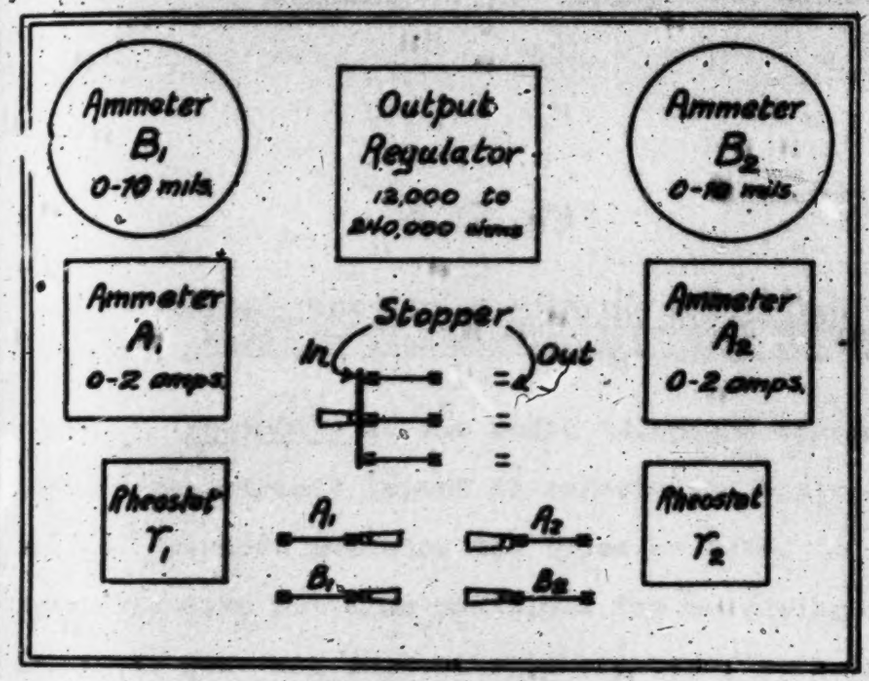
Note: Fig. 15 refers to first two stoppers built. See fig 15a for diagram of later model.

IBC May 27 1915

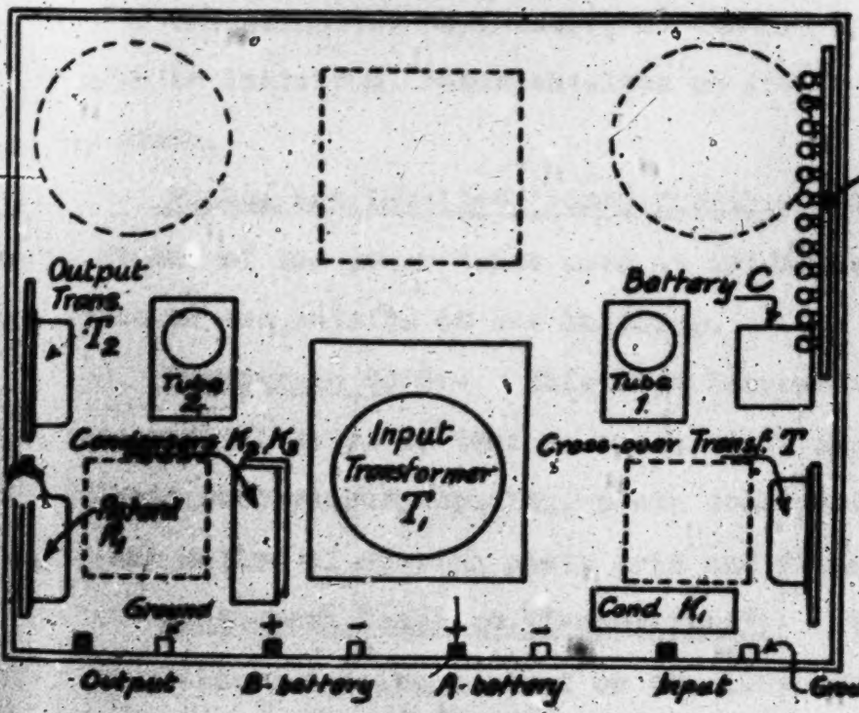
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WESTERN ELECTRIC COMPANY, INC.
ENGINEERING DEPARTMENT

SKETCH NO. ES 160377



— FRONT.



— BACK.

Fig 15a

STOPPER

Diagram of Box.

NOTE: Fig 15a refers to 3rd, 4th, 5th, stopper units; for diagram of 1st and 2nd see Fig 15.

BC. June 1. 1915.

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PLAINTIFF 6' EXHIBIT No. 19

Heising memorandum of November 19, 1930 and photographs relating to the Arlington transmitter

November 19, 1930

6 So-175

INFORMATION AND PHOTOGRAPHS CONCERNING THE ARLINGTON TRANSMITTING EQUIPMENT OF 1915

RE-460074 is the radio telephone transmitter circuit showing the circuit layout as regards the basic elements in the system. It does not show the types of tubes in the different sets. It does not show positions for measuring currents of voltages. It does not show circuit breakers, switches, nor methods of connecting the tubes in groups of 50.

The elements, oscillator, modulator, and first amplifier were in individual boxes shielded on five sides but opened on the sixth.

Photograph Labelled "Power Tubes":- This is a photograph of one of the power tubes used at Arlington. The photograph was taken on the outside of our building.

Photograph 8005:- This is a laboratory photograph of the same general class of tube as was used at Arlington to show approximate proportions, spacing, plate construction, lead-in wires, and method of spacing plate grid and filaments.

Photograph Labelled "Transmitter":- This photograph shows an ordinary telephone stand on the left with telegraph key, sounder, and clock used to carry on experiments. The telephone is a local phone, the telegraph line is a through circuit to

Mare Island and San Diego. The telephone on the right is the high quality microphone used in practically all the long distance talking tests. The phonograph on the right was used for playing music over the radio circuit during demonstrations.

Photograph 8826:- This photograph shows the oscillator in the top box. The lower box contains the speech amplifier which amplified signals from the incoming telephone line, when necessary.

Photograph 8827:- This photograph shows the modulator in the right-hand lower box and the first amplifier in the other two boxes. The circuits on the output of this amplifier are in the lower part of the lower box. The tubes were in the upper part of the lower box and in the upper box. The tubes in this amplifier were largely unbased tubes. The modulator tube was based. The negative voltage for the modulator and amplifier is supplied by the battery in the lower part of the modulator box.

Photograph 8828:- This photograph shows the power switchboard on the left and parts of the three rows of tube racks.

Photograph 8829:- This photograph shows the front of the first five racks of power tubes, each rack capable of holding 20 water-cooled power tubes. Between the first and second racks is a distributing rack in which were located large by-pass condensers, and the choke coils across the filaments

to give middle tap connection. This was also a distributing panel for plate leads, filament leads, and grid leads. The bottom of each rack contains a filament switch for the filaments of that rack, a plate switch and circuit breaker for the plate circuit, and a filter in the plate circuit lead.

Photograph 8796-A:- This photograph shows the rear of the first five racks and the front of the second five. Three racks of the second five contain sockets for holding mounted tubes. Otherwise they are similar.

Photographs 8881, 8882, 8818, 8819-A, and the unnumbered one:- These are photographs of various parts of the third group of racks which were constructed with iron frames, micarta panels and glass doors, and hold a total of 300 tubes. A blower for cooling the tubes is on the end.

Photograph 8886:- This photograph shows the antenna tuning coil with the primary coupled to it. Coupling was adjustable by sliding the primary and was operated from below. The tuning coil was in the attic.

Photograph 8884:- This photograph shows the outside of our special building showing two of our power transformers, the antenna lead-in wire to the building, and the bottom of one of the Arlington towers.

RAH:FH

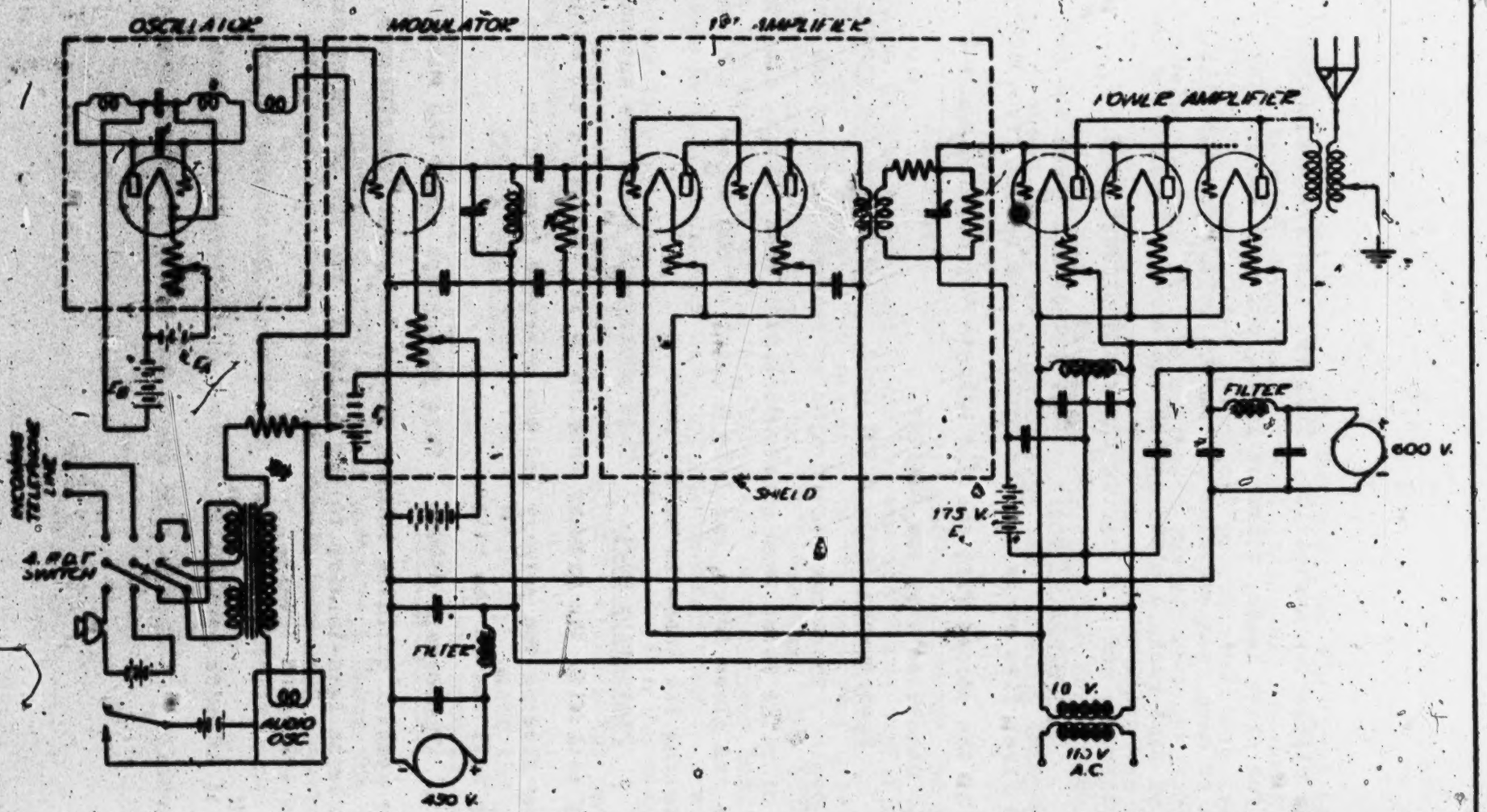
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RADIO TELEPHONE TRANSMITTER CIRCUIT
ARLINGTON, IN 1915



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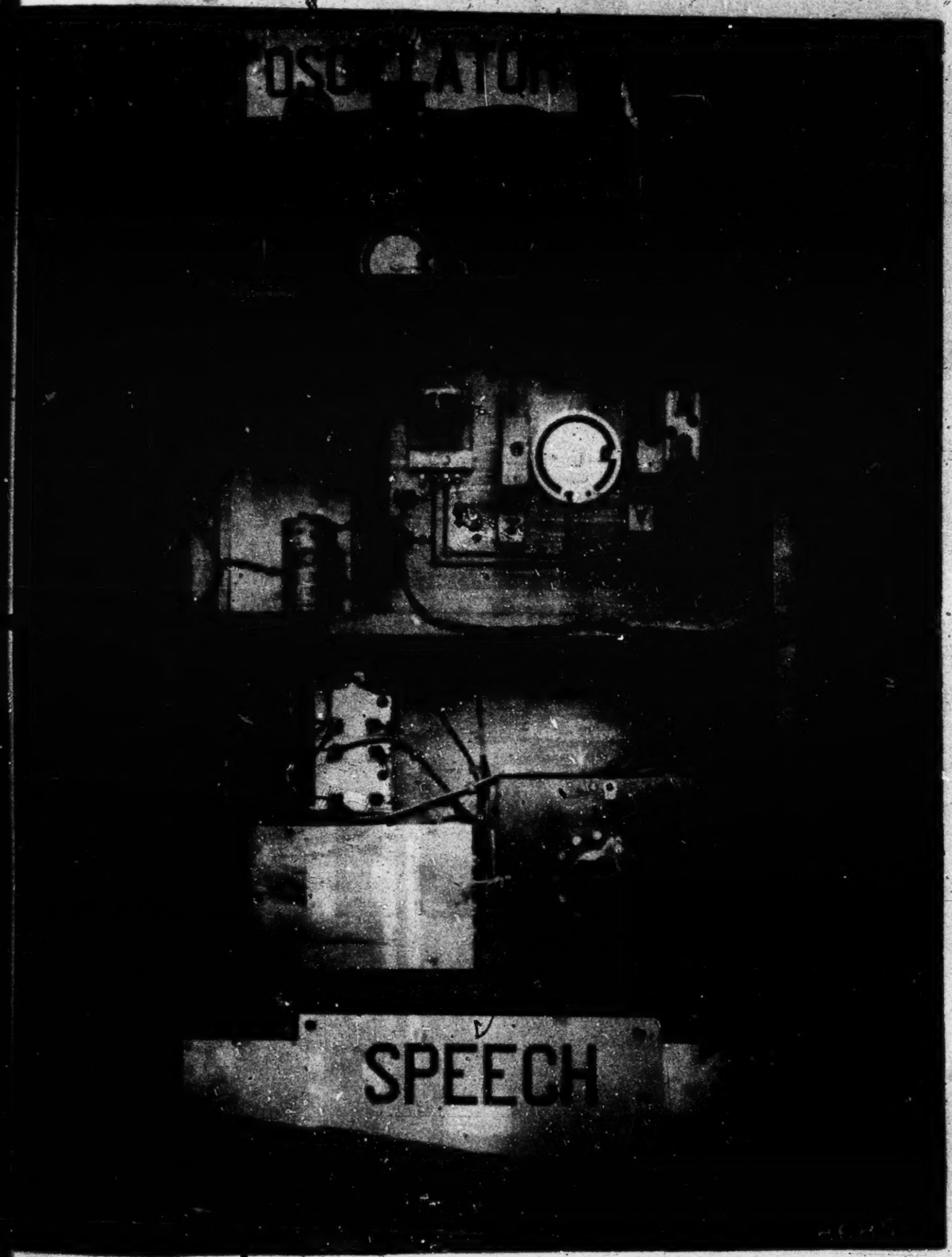
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TRANSMITTER

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SPEECH

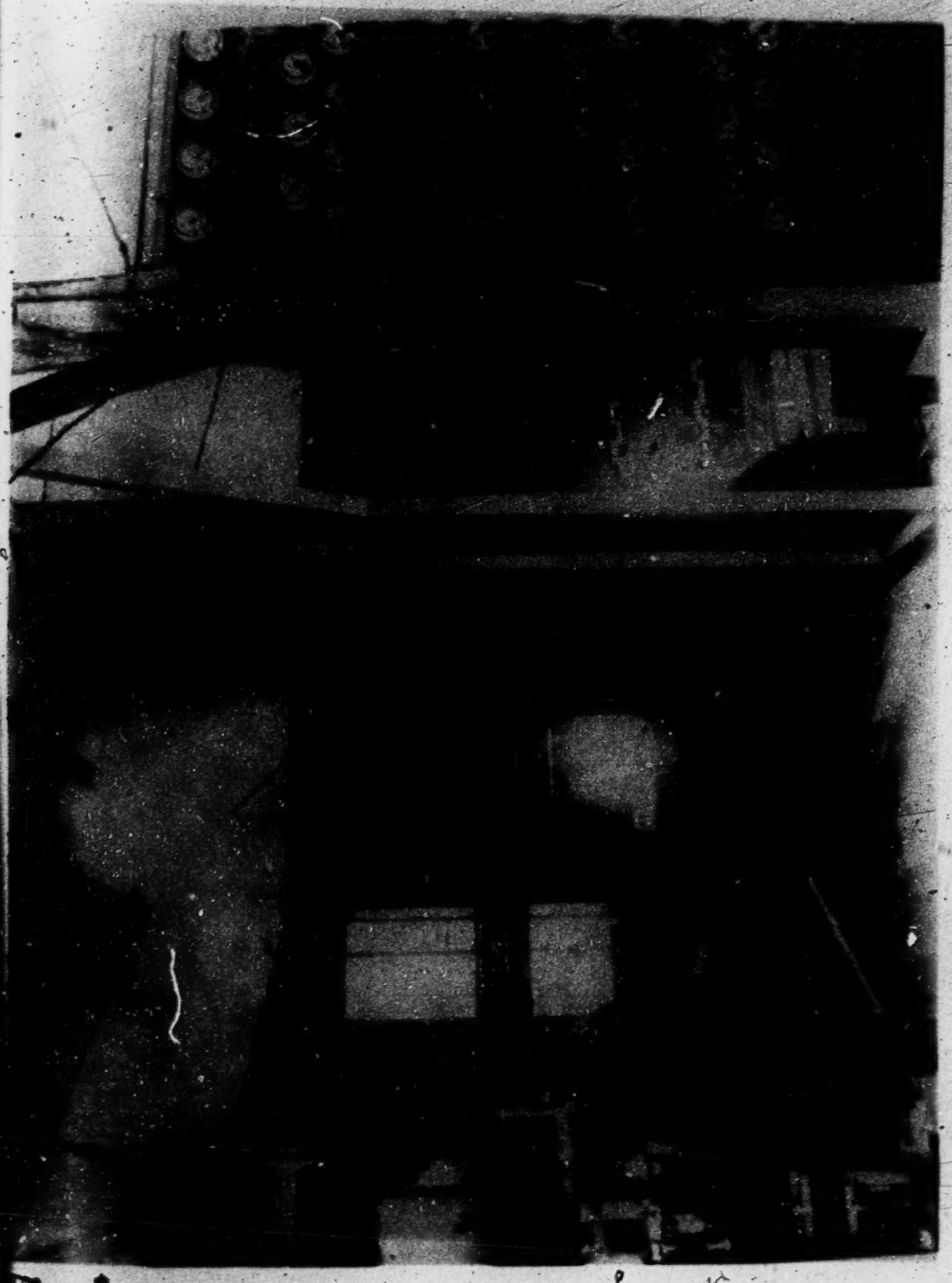
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AMPLIFIERS
MODULATOR

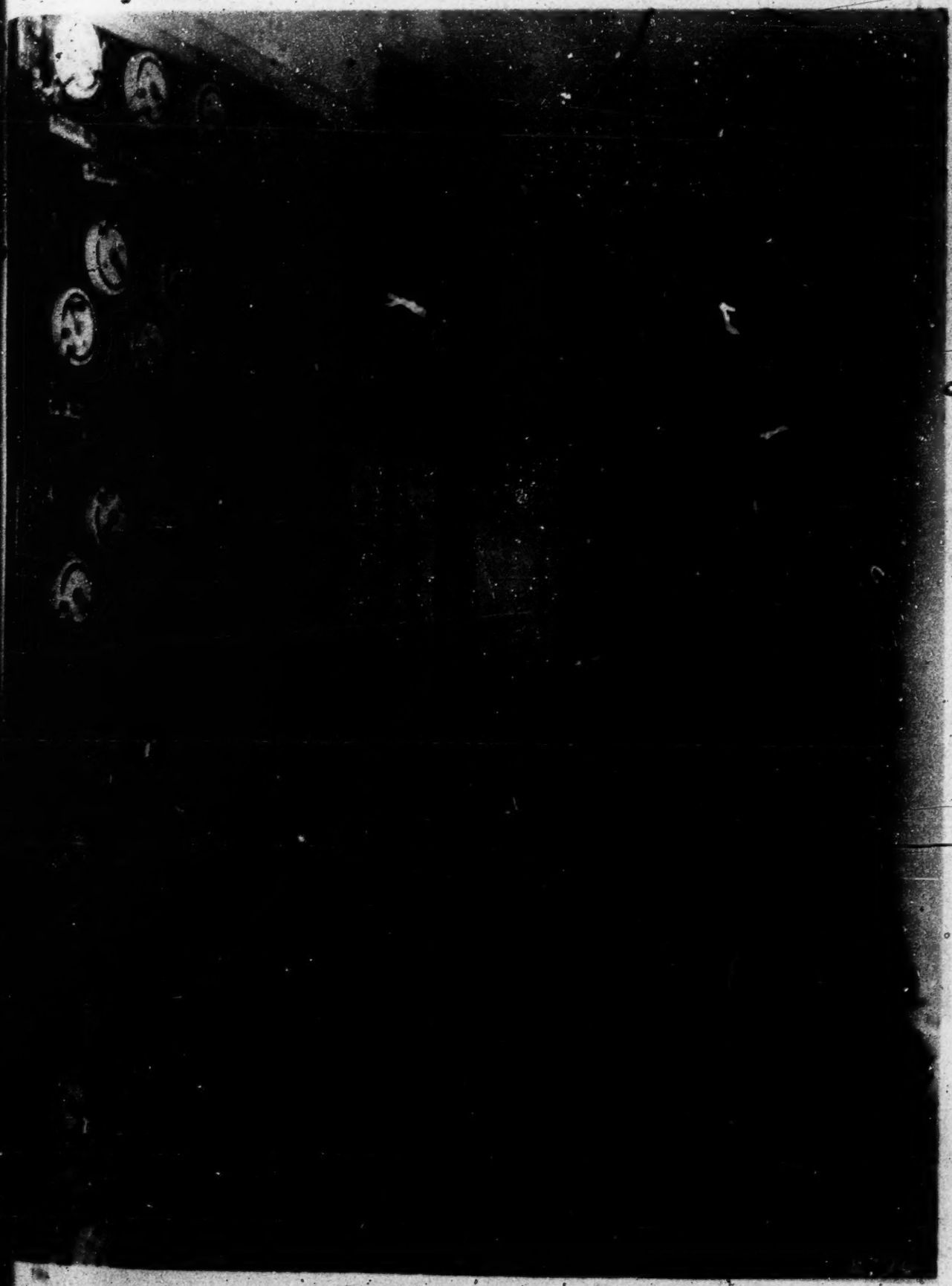
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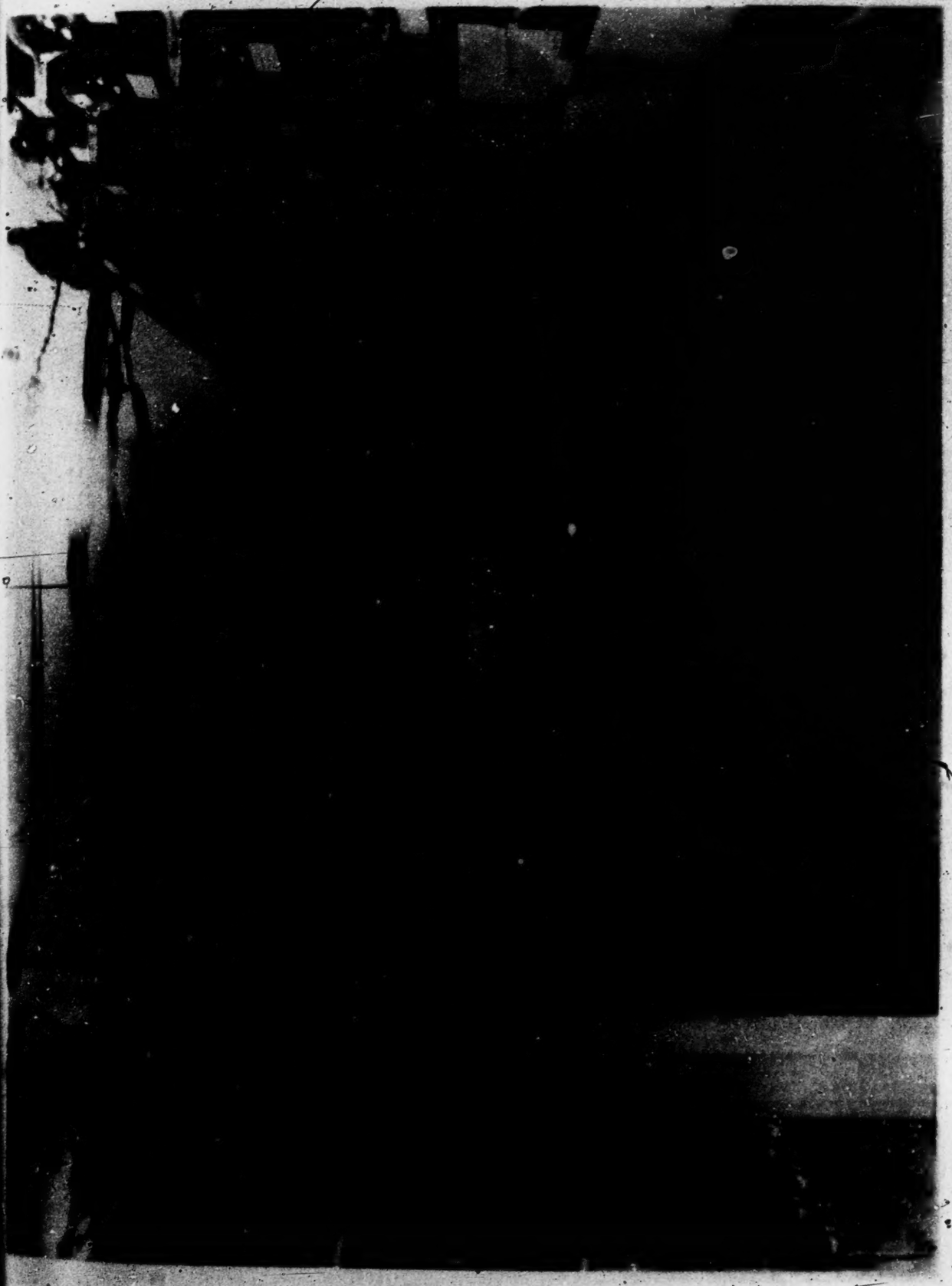
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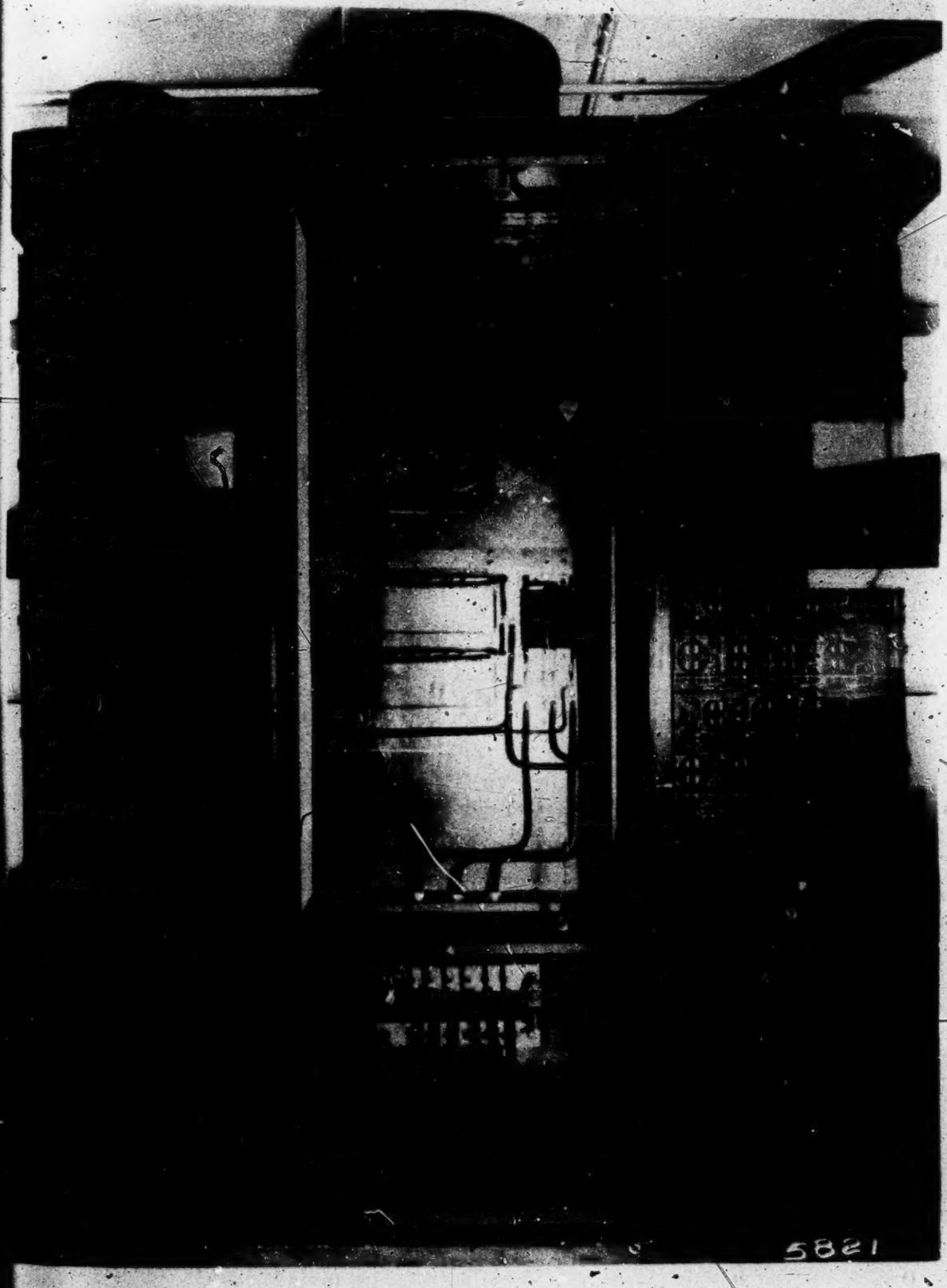
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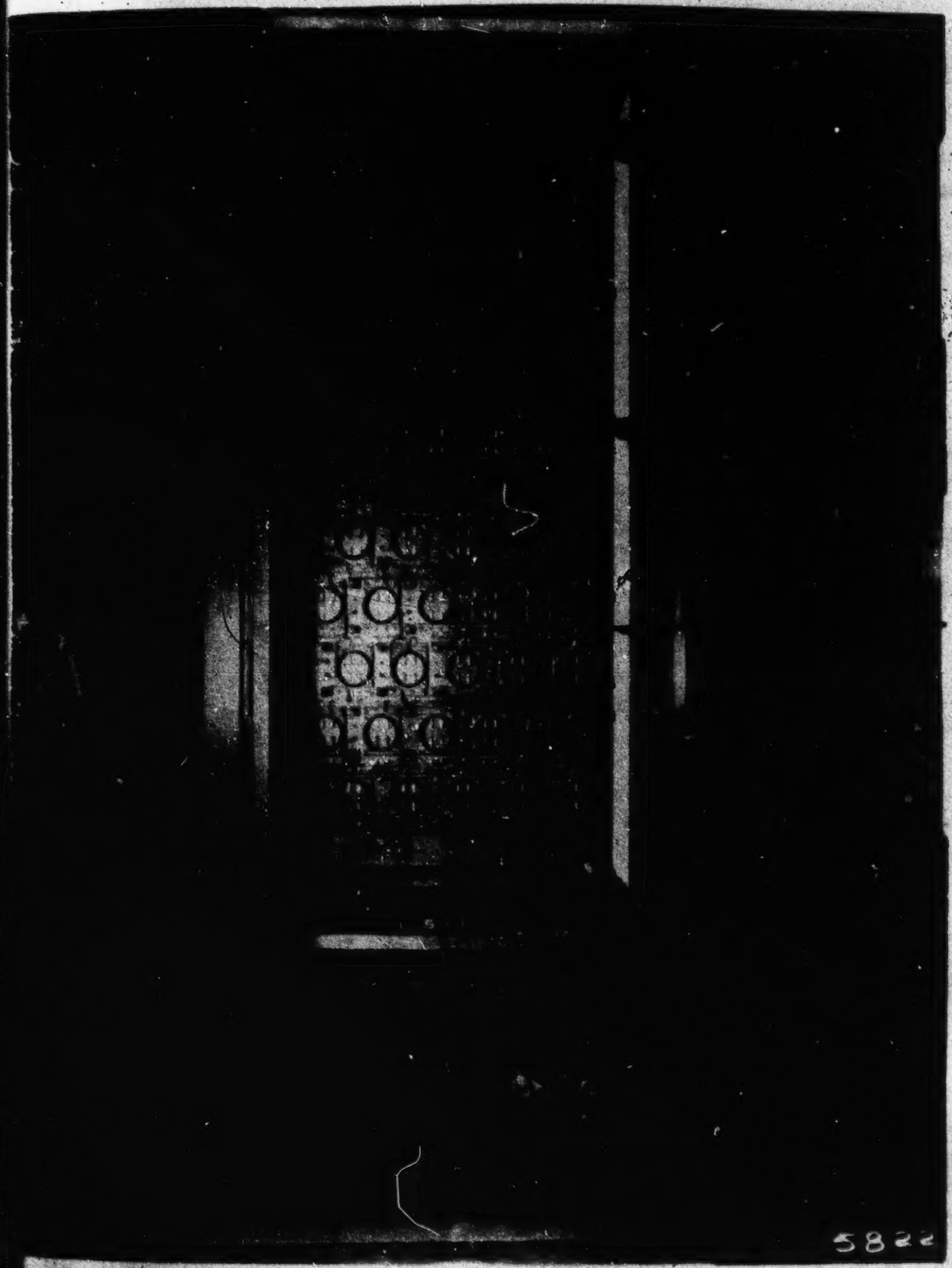
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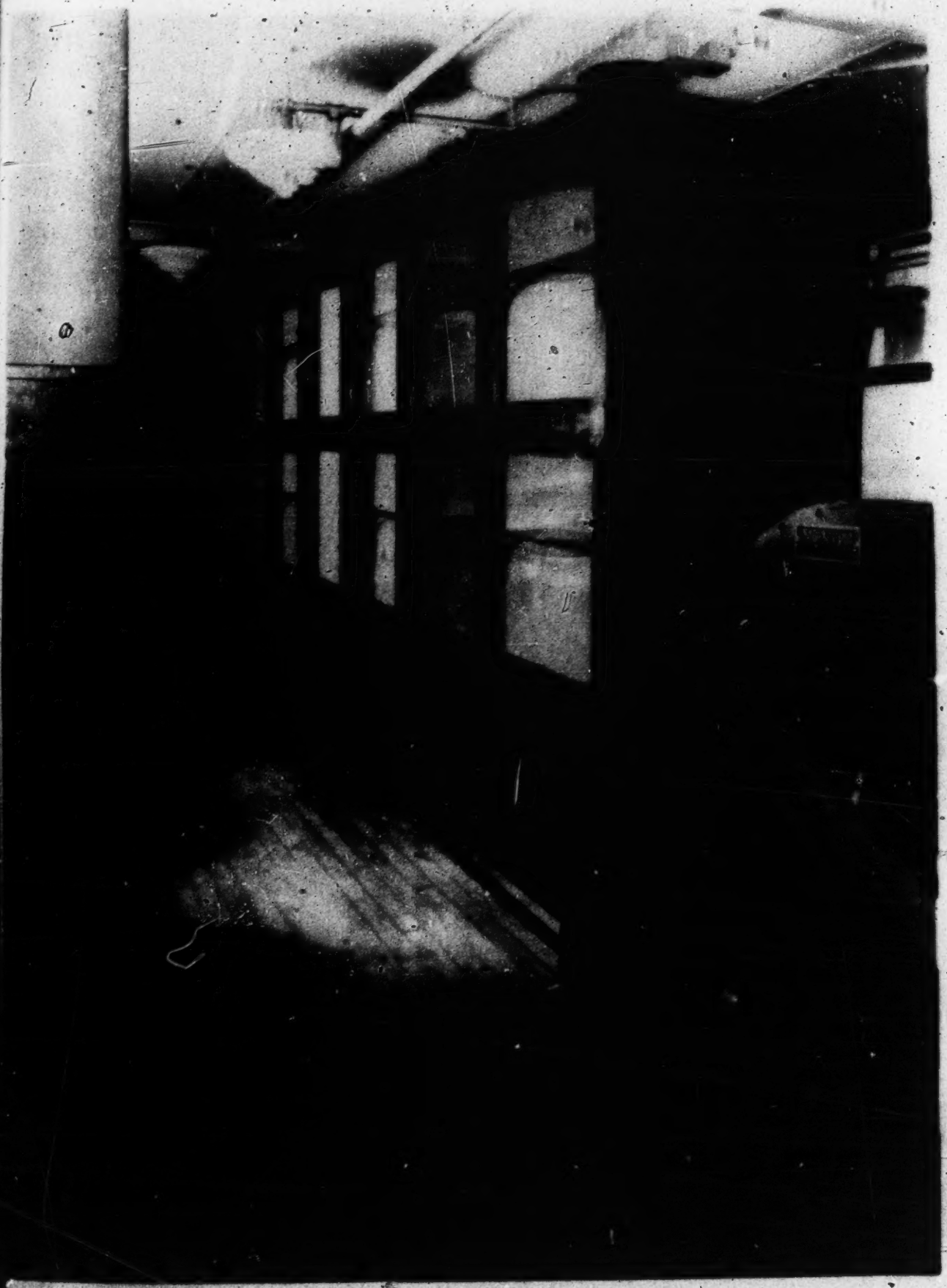
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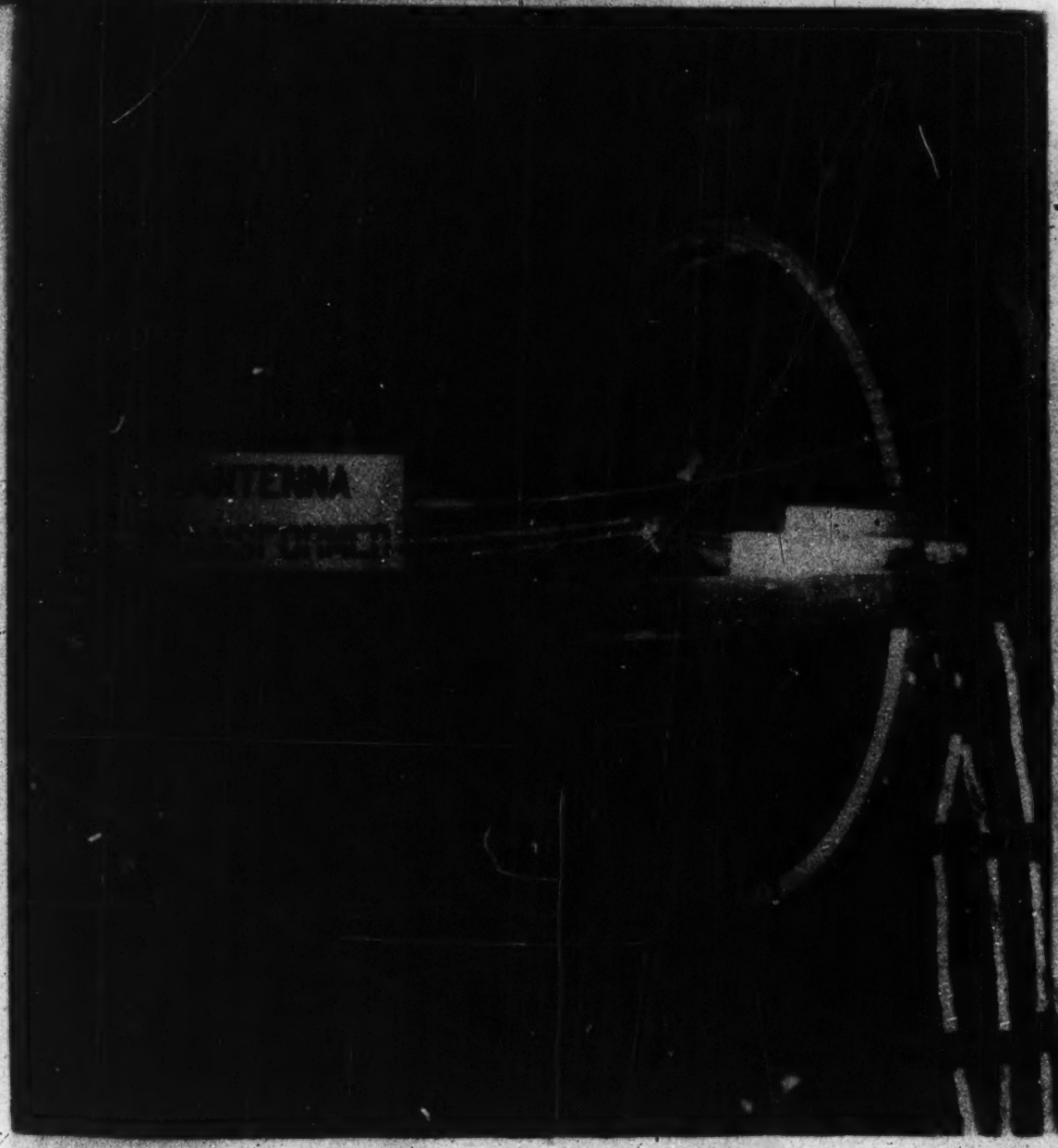
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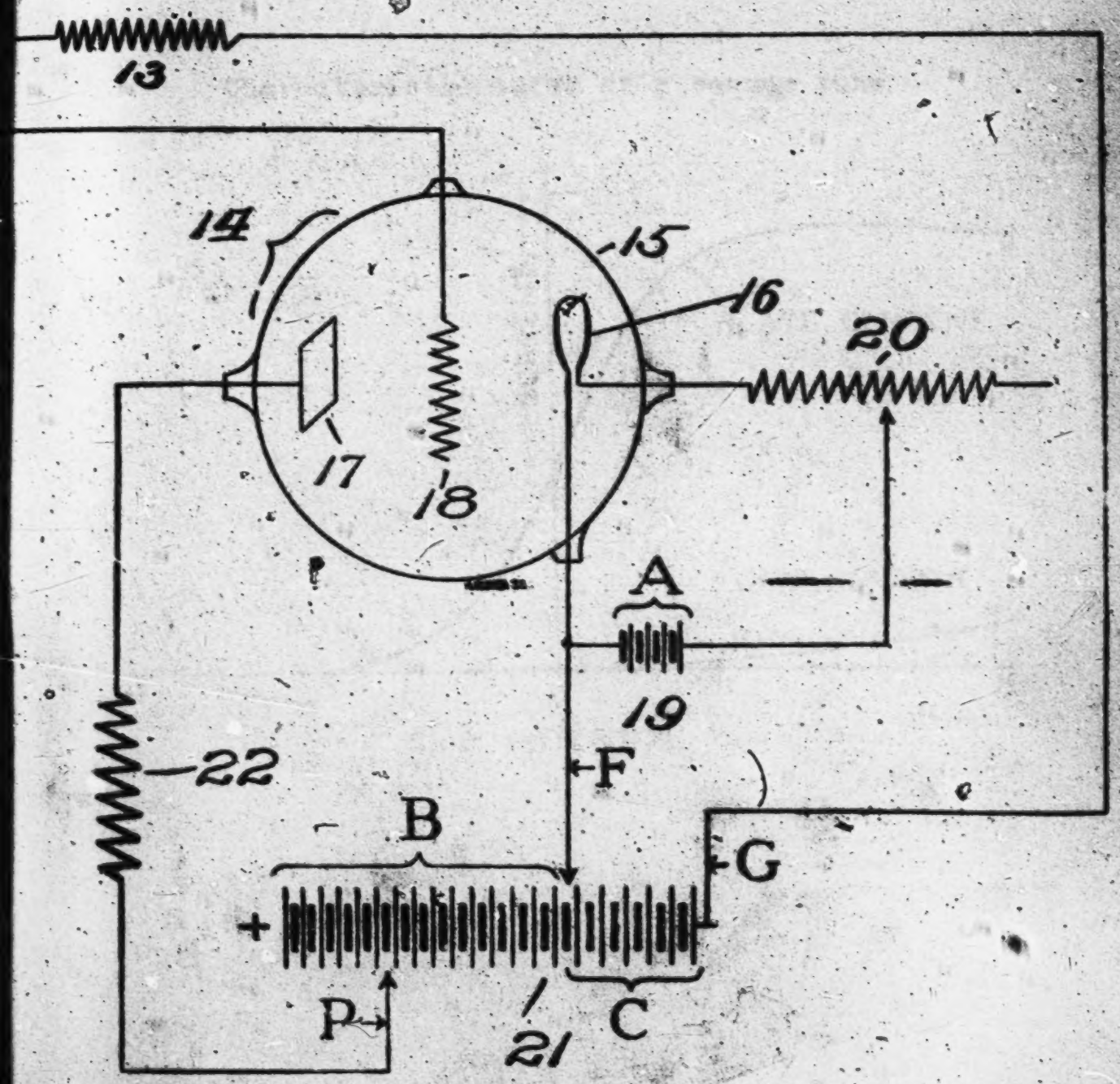
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Reproduction of part of the drawing of Lowenstein patent in suit No. 1,231,764, with reference letters added.

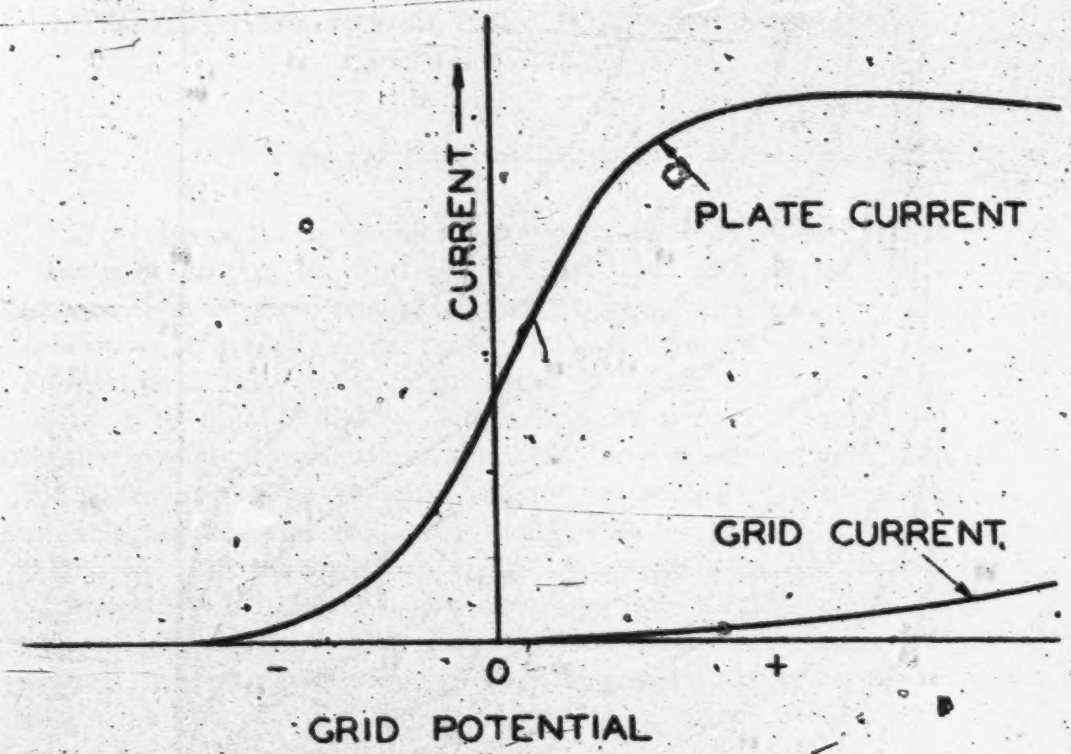


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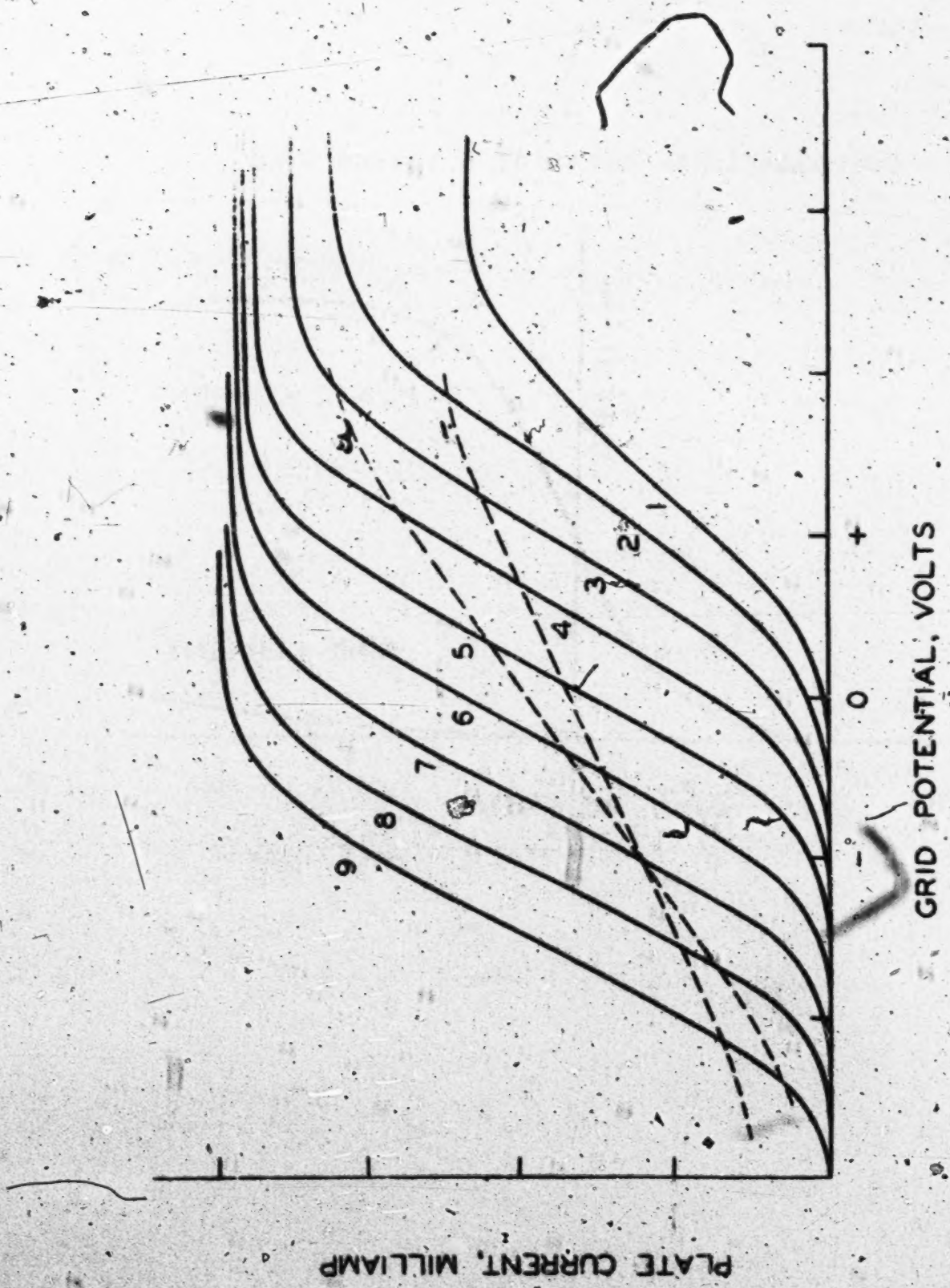
Characteristic curve of a vacuum tube



710

PLAINTIFF S' EXHIBIT No. 25

Characteristic curve of a vacuum tube



PLAINTIFF'S' EXHIBIT No. 26 711

Article by Lee De Forest in the Journal of the Franklin Institute of July, 1920

Journal of The Franklin Institute

Devoted to Science and the Mechanic Arts

Vol. 190 JULY, 1920 No. 1

THE AUDION—ITS ACTION AND SOME RECENT APPLICATIONS.*

BY

LEE DE FOREST, Ph.D., Sc.D.

ANALOGIES are apt to be interesting, and in scientific matters frequently instructive and clarifying. The title of to-night's paper, "The Audion," suggestive of *Sound*, prompts the consideration of an analogy in the realm of *Sight*—the microscope. The audion, in a measure, is to the sense of sound what the microscope is to that of sight. But it is more than a magnifier of minute sounds, electrically translated; the audion magnifies and translates into sensation electric energies whose very existence as well as form and frequency, would but for it remain utterly unknown. As the microscope has opened to man new worlds of revelation, studies of structure and life manifestations of natural processes and chemical reactions whose knowledge has proven of inestimable value through the past three generations, so the audion, like the lens exploring a region of electro-magnetic vibrations but of a very different order of wave-length, has during the scant thirteen years of its history opened fields of research, wrought lines of useful achievement, which may not un-

* Presented at a joint meeting of the Section of Physics and Chemistry and the Philadelphia Section, American Institute of Electrical Engineers, held Thursday, January 15, 1920.

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audion amplifier, and the scope and value of the new art immeasurably increased thereby. For example, the use of underground receiving antenna, the direction-finder, or radio-compass loop, the elimination of static interference by either of the above, or other methods—all such were compelled to await for their successful application the introduction of the grid electrode. Starting with the small bulb used in 1912–13 as a telephone amplifier and generator of minute electric oscillations for heterodyning purposes, I began the construction of larger sizes to be used in undamped wave transmission. At first spherical bulbs, three or four inches in diameter, and taking 50 watts of plate input energy, were considered large. Such rapid progress was made in improvement of design and construction of these so-called "power tubes," notably by the engineers of the Western Electric Co., that by autumn of 1915 a bank of several hundred tubes, their input and output electrodes connected in parallel, were installed at the Arlington wireless station. By a pyramidal circuit arrangement, whereby one oscillion tube controlled a group in parallel, these in turn controlling larger groups of oscillion tubes, some twelve kilowatts of undamped wave energy was delivered to the great antenna, all perfectly controlled or modulated by an ordinary telephone microphone. By this arrangement the voice was transmitted that year as far as Honolulu and Paris, thus fulfilling predictions made in 1909 to a very skeptical world.

In these Arlington tests the entire system was one of three-electrode tubes—for power generator, for current modulation thereof at the transmitter, and for detector and amplifier at the receiver. More recently Alexanderson, using his powerful high frequency alternator at New Brunswick, has controlled 80 kilowatts of antenna energy by means of his magnetic amplifier. This ingenious development of a Fessenden device was in turn controlled by a bank of large audion amplifier tubes, nicknamed "pliotrons," whereby the original microphone currents were sufficiently amplified to control the saturation currents necessary for the magnetic controlling device.

There are to-day grave differences of opinion among radio engineers as to what type of high-power radio transmitter will prove the key to the future—the high-frequency alternator, the Poulsen arc, or the oscillion. In my own opinion, the long-distance transmission art will shortly depart from true radiation

methods; and the a. c. generator, of comparatively *low* frequency, will be widely used for such subterranean, or submarine transmission, leaving for ship communication only the survival of

FIG. 15.

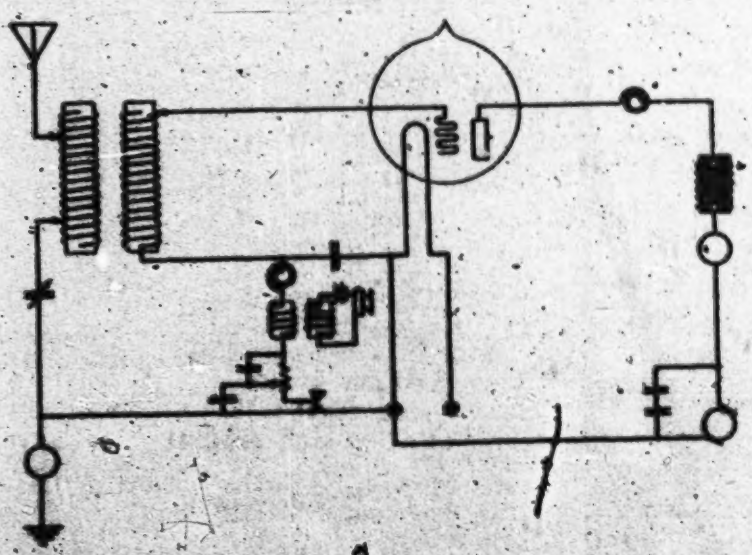


radio transmission, as it is known to-day. Such being the case, we will then have little use for *radio* transmitters of more than 20 to 50 kilowatts. For such transmitters I foresee the early use of a few large oscillion tubes, of say 5 kw. capacity each. Already we are making tubes capable of handling one and two kilowatts, using tungsten filaments and grids, and large anode

plates of tungsten or molybdenum. The efficiency with which several such tubes can operate in parallel, the ease with which an amplified voice current, acting upon their grids in parallel, can control their combined output make such a system almost ideal as a radio telephone transmitter. A typical oscillion transmitter utilizing two half-kilowatt tubes is illustrated in Fig. 15. The schematic circuit diagram for such a transmitter is shown in Fig. 16.

In the construction of these large tubes a thousand details must be scrupulously observed—in addition to the calculated physical

FIG. 16.



dimensions of the elements, the choice of materials, the method of seal, the preliminary treatment of the metals, their welding, the screening of the glass from bombardment, the various steps in the process of exhaustion—on careful observance of all these alone depends success in the manufacture of a high-power tube. A reasonably long life, of 500 to 1000 hours, is afforded by the tungsten filament, pure or alloyed with thorium; but this is by no means an ideal source of electrons. As such, tungsten, while preferable, is highly inefficient. By coating fine platinum ribbon with oxides of calicum, strontium, etc., or of the rare earths, similar to those in the Nernst glower, far higher emission efficiency is had, at lower temperatures, with resultant increase in life. But such oxide-coated filaments are fragile and very fre-

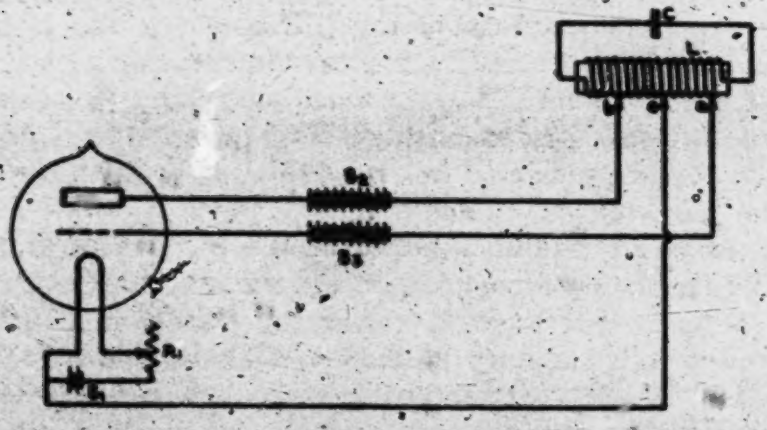
quently damaged during exhaust. Moreover, many types of coating lose their power of electron emission after a time. This method seems at best an imperfect makeshift. What the audion art awaits is a ribbon filament of some new, well-conducting alloy, wire drawn or rolled, of non-crystalline structure, emitting floods of electrons at a heat even lower than visibility. Reward awaits the metallurgist who first produces such a filament. For to-day the audion is being produced in quantities which in pre-war days would have been considered fantastic exaggeration. During the last months of the war the world production of such bulbs had attained the incredible rate of 1,000,000 per annum. And now the demand in America alone, chiefly from radio amateurs and experimenters, is at the rate of some 5000 per month, and constantly growing. And most of these latter are used singly or in two-step amplifier arrangements. During the war, however, thousands of amplifier and transmitter instruments, each requiring 3 to 9 bulbs, were in use—in earth telegraphy, in submarine listening, in telegraphy by ultra-violet or infra-red rays, in gun-spotting, airplane detection, etc., in addition to those required for ordinary radio telegraphy and telephony.

The necessary conditions for an audion to function as a generator of alternating currents have been the subject of exhaustive study by many investigators, notably by Hazeltine, Ballantine, and Mills in this country; Vallauri and Eccles abroad. There are to-day countless circuit arrangements whereby the audion may be caused to generate such currents; but in all of the practically useful ones, where considerable power is required, the inductive linking of the grid and plate circuits, analogous to that first used in 1912, is in one form or another employed. One of the simplest forms of such circuit is shown in Fig. 17. If there is no time lag in the electronic stream behind the pulsations of grid voltage, as is the case in a highly exhausted tube (up to frequencies of ten million per second), then the above arrangement becomes an alternating current source whose frequency depends upon the natural frequency in the LC circuit. The period of this oscillation is very nearly $2\pi\sqrt{LC}$ if the resistance, r, of the external plate circuit is small, the resistance, or reactance, p, of the plate-filament gap is great, and provided the mutual induction, m, between the inductances in the grid-filament and plate-filament circuits is just sufficient to maintain the oscillations.

If, then, $m \geqq \frac{1}{K}\left(\frac{L}{\rho} + r.C\right)$ this oscillating condition is realized; and K in this formula can be defined as the "amplification factor."

One of the latest developments in the oscillion transmitter is the application of alternating current for the plate voltage supply. Sixty cycle current is taken from a lamp socket, stepped up to 500 or 10,000 volts (according to the size of the transmitter)—the two halves of the cycle rectified through two-electrode vacuum valves, this rectified current stored in a suitable condenser, smoothed out by an appropriate "filter" circuit, and finally delivered as high-voltage direct current to the plate-filament circuit of three-electrode oscillator tubes. The filaments of both recti-

FIG. 17.



fiers and oscillators are lighted from the low-voltage windings on the one transformer. Such an arrangement does away with the motor generator converter, and even with 60 cycle supply gives surprisingly clear voice transmission. A small set of this type employing two rectifier and four small oscillating audions in multiple is shown in Fig. 18. With this small unit, consuming 50 watts and putting three-quarters of an ampere in an average antenna, one has recently telephoned fifty miles.

The developments by the engineering staff of the Western Electric Company of the audion amplifier as a telephone repeater, since my first demonstration to them of its possibilities in that field, are beyond all praise. The real and rare understanding of the elements of the problem with which this staff of trained men developed the amplifier and applied it to the long-sought trans-

continental telephone line stand unique in the annals of brilliant achievement in electrical engineering.

The time was ripe. Had the audion amplifier been presented at a much earlier date it is unlikely it would have then met the warm welcome which twenty years of futile search for the telephone repeater had earned for it. It was the irony of inventive fate that this revolutionary telephone device was to come, not

FIG. 18.



from those whose efforts had for years spun in the old rut of the receiver-microphone "siameesed" together, but from an art younger than telephony, from a device conceived for a quite different application—a wireless telegraph detector.

"From small beginnings the transcontinental line has been evolved. One element after another came. First the telephone receiver of Bell; then the Berliner—Edison microphone; then adequate line construction; the Pupin coil to prevent voice distortion—and finally the one missing link, the Audion Amplifier. Try to imagine one of the electronic carriers of the voice currents in this amplifier, and contrast it with a carbon granule of

a microphone transmitter of the early telephone relays. Compare a soap bubble with a load of coal, and you will have some relative idea of the distinction between the delicacy and elegance of the audion and that of the old microphonic relay." A more revolutionary step was never taken in the history of electrical engineering.

A repeater suitable for our present wire telephone system should supply energy amplification sufficient to restore the attenuation produced by twenty miles of standard cable. This actually means that the repeater must be capable of delivering 256 times as much energy as it receives; that is, possess a telephone efficiency of some 26,000 per cent., and this without appreciable distortion of the most intricate of voice current waves, involving all frequencies from 100 to 3000 per second. Any repeater or amplifier which produces distortion of the speech currents is to that extent unfitted for use in tandem operation, because the distortion is cumulative in the successive repeaters; and mechanical amplifiers generally, and even the best of that type, produce distortion.

A large amount of unnecessary secretiveness or mystery was for some time thrown around the type of telephone repeater which made possible transcontinental telephony.

A well-known telephone engineer has recently stated that the audion amplifiers used by the American Telephone and Telegraph Company are practically distortionless, and are commercially used in tandem operation in regular installations, and were so used in the first transcontinental line, which would have been impossible without the use of the tandem arrangement. By actual trial over cable circuits approximately one thousand miles in length it has been found that as many as thirty of these audion amplifiers can be connected in tandem and produce excellent speech at the receiving end of the line. This engineer is authority for the statement that computation shows the attentuation of a cable circuit of this length to be so enormous that if all the power received on the earth from the sun could be applied in the form of telephone waves to one end of the line, without destruction of the apparatus, the energy received at the other end would be insufficient to produce audible speech without the use of amplifiers; whereas with 30 amplifiers used in tandem the relatively minute energy of ordinary telephone speech currents at the transmitting

end produced speech in the receiver at the opposite end which was both loud and clear, the amplification due to such a tandem arrangement of tubes being of the order of 10^{50}.

The audion which has been evolved to meet these requirements, most rigorous of all its numerous applications, differs in many details from the detector or the oscillating audion. The presence here of gas ionization sufficient to cause appreciable distortion cannot be tolerated, neither must the grid be permitted to be positive at any phase of the cycle of impressed voltage. A hundred other minor requirements, small yet difficult of realization, have been patiently achieved by our telephone engineers, who now state that "the amount by which it (the audion amplifier) fails to meet all the requirements for a perfect repeater is so small as to be negligible except under the most rigorous conditions."

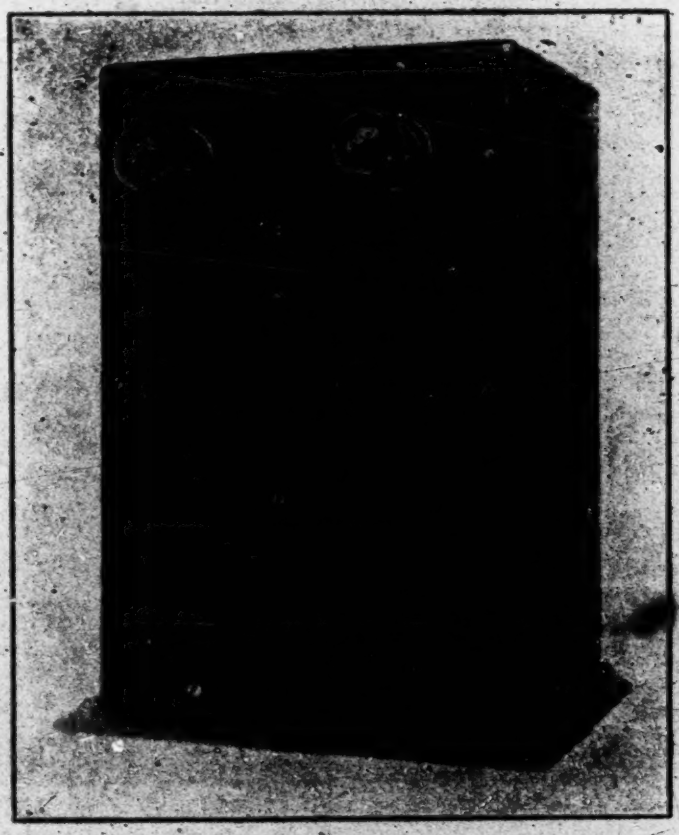
FIG. 19.



The illustration (Fig. 19) conveys a more vivid idea than any description of the thorough completeness with which the

American Telegrapn and Telephone engineers have applied the audion repeater to the commercial long-distance telephone service. It illustrates a typical group of repeater racks, each rack carrying two complete repeaters. This view was taken at one of the main repeater stations on the Boston-Washington underground cable line, located at Princeton, N. J.

FIG. 20.



Two-stage audion amplifier.

Popular attention has been attracted to the success of the recently announced application to line wires of wireless methods of transmission, reception and tuning, whereby multiplex telegraphy and telephony have been made possible over wires already loaded down with their ordinary communication. The original ideas of such multiplex telephony date back to the early nineties, when John Stone Stone, Hutin and Leblanc disclosed methods all involving the same principle, that several alternating currents of

superaudio-frequency, each from a separate source, could be directed over the same wire or pair of wires, each be modulated or controlled by its own microphone, or Morse key, and at the receiving station each frequency taken off by its own properly tuned circuit, and there retransformed into its own original telephone or telegraph current. But none of these early investigators utilized at that time the all-necessary integrating detector which

FIG. 21.



50-Watt amplifier.

was alone capable of retransforming the modulated high-frequency wave-trains back into their original audio-frequency currents. Here again the wire telephone requirements had to await the advent of a radio-detector.

General (then Captain) George O. Squier in 1910 carried out certain experiments which are destined to become classic as the new art of wired-wireless attains the important commercial proportions to which it is unquestionably destined. He, for the first time, used a constant, reliable source of undamped electric

currents of high frequency for the transmitter, and an audion detector between each tuned receiving circuit and its telephone receiver. By this combination multiplex telephony became at once a realized fact.

But so long as a high-frequency alternator was required at each transmitter station the wired-wireless idea could not become commercialized. Its first cost, the size and weight of it with its motor, its delicacy of speed regulation, its limitation to relatively low frequencies, all made this impossible. So again an important development was compelled to await the advent of the oscillating audion.

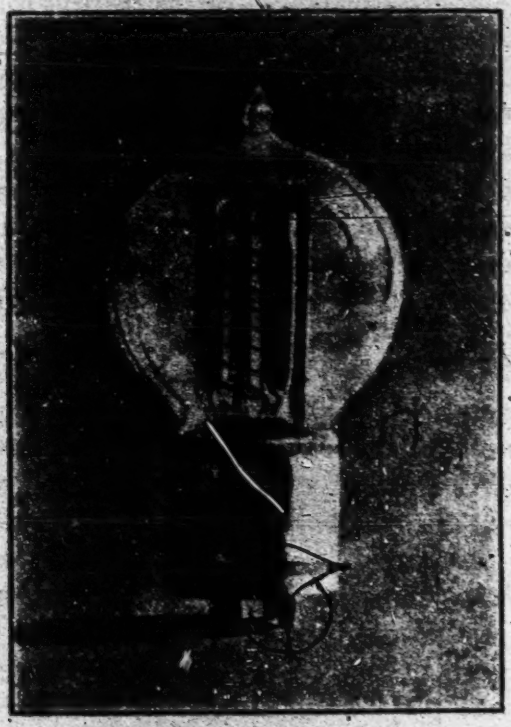
Supplied from a common filament-lighting battery, a common "B" battery, or d. c. generator, any desired number of tiny alternating current generators, each driving its own easily tuned circuit, can now be assembled in a small central station. The grid of each oscillator is voice-controlled from its local telephone circuit, and as many high-frequency "carrier" wave-trains superimposed upon a single trunk line pair, as it may be feasible to use without interferences between the modulated frequencies of the several conversations.

At present carrier frequencies ranging from 5000 to 25,000 have been used commercially over a single pair of telephone wires, between Baltimore and Pittsburgh. A zone of frequencies of 2500 is allotted to each conversation, which permits of eight simultaneous telephone conversations over the line, in addition to the usual "physical circuit" conversations. The constant frequency generated by each individual oscillion lies in the middle of each allotted zone of wave-frequencies, but the modulation of this "carrier wave" by the voice currents results in a wide band of frequencies (analogous to a spectrum band) on each side of the particular carrier-wave frequency. This means that at the receiving station it is preferable to employ, instead of a circuit attuned to the single frequency of the carrier-wave, a "band-filter," or combination of several tuning elements (inductance and capacity). This band-filter, then, is equally receptive to any wave-frequency lying within the prescribed limits, say 1,250 cycles on each side of the carrier-frequency, but offers very high impedence to all frequencies above or below the limits of the band-frequencies. By eight such band-filter receiving circuits the eight conversations are segregated, each delivered to its own

proper audion detector and sent out on its own local telephone line.

But it is by no means necessary to limit wired-wireless to the use of such low frequencies as we have been considering. Certain tests were recently carried out in Canada which proved conclusively that frequencies as high as 500,000 per second can be used over telephone lines, including several miles of cable, without harmful attenuation. This demonstration widens very

FIG. 22.



Western electric audion amplifier.

greatly the range of frequencies available for wired-wireless, with hope for a corresponding increase in the number of conversations, or telegraph communications, which can be placed upon a single pair of wires, or group of pairs. Moreover, with such high frequencies (say from 100,000 to 300,000 per second) the necessity for complicated band-filter receiving circuits vanishes, with obvious attendant advantages.

Wired-wireless is the youngest of the large family of methods for electrical communication of intelligence. He is indeed a

bold prophet who will to-day attempt to foretell the limits of its application. That the great saving in line costs, the vast multiplication of available channels of long distance communication which it makes possible will work profound changes in our present methods of business, cannot be questioned. Thus again it seems evident that the audion is destined to play a leading role in the work of knitting more closely the people of this land, and of all lands.

We have briefly recounted some of the main achievements which the three-electrode audion, or triode, has to its credit. Let us now consider some of the possibilities of its future. From its invention until 1912 it attracted an almost negligible interest in the scientific world. A year after the audion was first brought to the attention of the engineers of the American Telegraph and Telephone Company that corporation acquired exclusive license under all the audion patents for wire telephone purposes. Thereupon the research men of that organization initiated an elaborate line of investigation of the device, which about that time began to interest other scientists in America and abroad. Prior to 1914 not a dozen articles on the audion had appeared in scientific publications. To-day it is impossible to pick up a magazine directed to physics or electric communication without finding one or several papers dealing with some of what Dr. Eccles styes "the protean properties of the ubiquitous three-electrode tube."

Writing in the *Radio Review*, Dr. Eccles (who is affiliated with the British Marconi Co.) says: "The most important single instrument in modern wireless practice is the three-electrode thermionic vacuum valve, for it enters into every main division of the subject—it plays a dominant part in the generation of oscillations, the detections of signals, and in the amplification of feeble voltages and currents. Its arrival and devolopment have, besides, helped greatly towards the success of apparatus and methods that might otherwise have remained almost failures."

Dr. Eccles has outlined the present status and forecast of the future of the audion so clearly that I am constrained to quote further his words, as those of an unbiased observer: "During the war, hints reached the civilian that a revolution was taking place in wireless telegraphy, the principal agent in which was reported to be an instrument called a 'valve,' a 'lamp,' or a 'tube.' This instrument seemed to have arisen suddenly into a predomi-

nant position among all the apparatus of the wireless experimenter and operator, and appeared to be of use in every corner of his outfit. The complete name of the instrument is the three-electrode thermionic vacuum tube. It must be emphasized that it is the three-electrode valve, and not the valve with two electrodes, that has been responsible for the overthrowing of the old

FIG. 23.



1 Kw oscillion.

methods and apparatus. That it has been a veritable revolution can be seen by comparing the common practice in wireless telegraphy of 1914 with that of 1919. In 1914 practically all the most powerful transmitting stations in the world generated waves by sparks and signals were receivel at nearly all stations by means of crystal or magnetic detectors. The spark method of generating waves involved the use of very large an-

tennæ for spanning great distances; and at the receiving stations which wished to listen to stations more than even 100 miles away very large aerial structures were customary. But if we look at the state of affairs to-day we find most of the high-power stations for long-distance transmission are 'continuous wave' stations; that is, they produce uniform uninterrupted waves instead of a series of short gushes made by sparks; while at the receiving end new modes of detecting these continuous waves appropriate to, and taking advantage of, their uniformity in character have been introduced. This is where the three-electrode tube, in various adaptations, enters the arena. Taken together, the improvements at both ends of the span have made possible the use of smaller antennæ at transmitting stations, and have almost removed the necessity for any antenna at all at receiving stations. For example, under reasonable weather conditions, it is quite easy to listen to the messages coming from stations on the other side of the Atlantic by using a receiving circuit of which the receptive element is a small coil of wire, three to four feet square. Thus, so far as receiving goes, it is possible to intercept all the great stations on one-half of the globe by means of apparatus contained wholly in one room, or even in a cupboard. In accomplishing this the magnifications in use amount to several hundred-thousand-fold. All this is the work of a thing which looks like an ordinary electric-light bulb with a few extra pieces of metal in it—the three-electrode tube."

Years ago what physicist did not look at the simple, self-contained, noiseless incandescent lamp, consider it as an ideal source of electro-magnetic waves of a wide spectrum—of heat, visible, and ultra-violet radiation, and wonder why it should not be made to generate also waves of any length? To-day that incandescent lamp, with the addition of a metal plate and wire grid, has become such a generator. Undamped Hertzien radiations of a few centimetres' wavelength can be generated by audions specially designed to give minimum capacity between the three-electrodes and their lead-in wires. From these short waves, representing alternating current frequencies of some hundreds of millions, down to those of one or two per second, the electric-wave spectrum afforded by the oscillating audion is continuous. Consider this fact in connection with the almost infinite sensitivity of the device as a detector, and its unlimited power as a magnifier,

or amplifier, and one realizes something of the value of the three-electrode vacuum tube to the physicist and the inventor. To the former, however, the keenest interest lies perhaps in the audion itself, because there is no known piece of electrical apparatus linked so directly with the most recent work on the structure

FIG. 24.



"VT-21" signal corps audion.

of matter. A prominent British physicist has recently remarked: "It is probable that there is no other sphere where research work has had such a combination of immediate practical value and intense theoretical interest."

Many an early experiment in telegraph transmission or reception by wire or wireless, long since abandoned as too limited in

range, can to-day be revived to the great benefit of man. Calculations have shown that with a littoral cable stretched for 50 miles on each side of the Atlantic, and carrying some forty amperes of 20-cycle alternating current, telegraphic communication by conduction or leakage currents should be possible, using the audion

FIG. 25.



½-Kw oscillion tube.

as detector and amplifier. I venture to prophesy that within a few years the tall towers and the atmospheric disturbances, which have for two decades been esteemed necessary evils in trans-oceanic wireless signalling, will be regarded with those sentiments which we now bestow upon the coherer and the spark.

But more than this. Signalling by conduction currents of relatively low frequency will soon be practiced through the earth as well as water; and we will find the antennæ of the future thrust

upside down, as into abandoned oil-well borings, and making contact with deep semi-conducting strata, at points separated by a few miles; the two inverted antennæ of such a transmitter connected by an overhead power transmission line containing the alternating current generator and signalling device; and a similar arrangement for receiving. Then our wireless messages will go through the earth's crust, or possibly by a more direct path, and not around the earth's surface, to be tangled up as at present with a bewildering snarl of static ravellings. The audion amplifier stands ready to lead us back to the simpler methods of Morse and Lindsay, meritorious methods long ago abandoned because of the lack of an electric ear of indefinitely great sensitiveness.

The future of radio signalling at sea lies with the telephone rather than the telegraph. The simplicity, the reliability with which the medium of an undamped wave-carrier, ideally suited for voice transmission, can now be had will rapidly limit the crudity and laboriousness of the Morse code signalling between ships. Yet to-day scarcely the dawn of this new epoch has been seen. Vessel owners are to-day almost as skeptical regarding the practicability and utility of the radiophone as we pioneers found them towards the wireless telegraph sixteen years ago!

In the future during fogs at sea a short-wave radio telephone will be used to prevent collisions, distances being determined (as wall as direction) by conversation, whistled signal or bell, and a calibrated stop-watch. This service will be quite independent of the long-range wireless signalling. The new radio has also a wide field of usefulness in telephoning between islands, thousands of which will never be linked by cable. Other useful fields await in sparsely peopled countries, between mines, oil wells, forest patrols, from express trains, etc. The future of aviation will be found linked with radio telephone, for a score of different purposes. Telephony by audion transmitter, receiver, and amplifier not only carries the complexes of human speech without distortion, but delivers them where human speech itself is impossible otherwise—amid the deafening motor and propelior noises of the airplane, from one to five miles above the earth.

Little imagination is required to depict new developments in radio telephone communication, all of which have lain fallow heretofore awaiting a simple lamp by which one can speak instead of read.

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PLAINTIFF'S EXHIBIT No. 25

Photograph of Defendant's amplifiers



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2191

Plaintiffs' Exhibit No. 32.

(Letterhead of)

GENERAL TALKING PICTURES CORPORATION
Executive Offices
218 West 42nd Street
New York City

318 East 48th St.
November 17, 1928

2192

American Transformer Co.,
Newark, N. J.

Gentlemen:

Attention Mr. Crumm.

I am informed that you are now manufacturing an amplifier panel for use in connection with phonograph and the like in theatres.

Kindly furnish the writer with a complete detailed information regarding the prices in lots of 10 and more and guaranteed dates of delivery. 2193

I assume that this apparatus is licensed under RCA patents.

Awaiting your immediate reply.

Yours very truly,

GENERAL TALKING PICTURES CORP.
LEE DE FOREST

2194

Plaintiffs' Exhibit No. 33.

November 23, 1928.

General Talking Pictures Corporation
218 West 42nd Street
New York City.

Attention: Mr. Lee de Forest.

Gentlemen:

2195 We have your letter of the 17th in regard to amplifiers to be used with phonograph and the like in theatres.

The license which we have with the Radio Corporation of America is that the amplifier is to be used for broadcasting reception and for experimental and amateurs use only and not for commercial use. That is the type of license notice which is placed upon the amplifier and is the only way which we can sell them.

We are enclosing a bulletin on the last page of which is a general description of the type of
2196 amplifier to which we are referring. This amplifier can be made up in quantities at a price which is dependent on a large measure on the details of the input and output circuit required. These two points are critical and have to be designed to fit the input circuit and the load that is to be placed on the amplifier so that if you wish to obtain any of these amplifiers, it is necessary to have a good deal of information regarding the output circuit.

In general, the amplifier is furnished to operate from a radio receiver located at some distance from the amplifier and the connection be-

Plaintiffs' Exhibit No. 33. 2197

tween the two is made by means of a 200 ohm line and proper stepdown and stepup transformers. The control of volume is either ahead of the detector tube or in the 200 ohm line. The amplifier consists of three stages of audio, completely operated on A C using 27 tubes in the first stage, push-pull 26 tubes in the second stage and push-pull 260 tubes in the third stage, either two or four as desired. The output circuit is preferably designed to operate through a 200 ohm line so that the energy can be distributed 2198
to the speakers at some distance from the amplifier using stepdown transformers at the end of the line to match the impedance of the various speakers.

The list price on such an amplifier is approximately $1200.00 and there is a large discount for quantity orders. In general, the discount is 50%, but as mentioned before, the direct price is dependent on the output circuit and it does not pay to quote any definite price until we have more definite information.

Delivery can be made in about five weeks from 2199
receipt of order and complete information.

I will be very glad to go into further detail with you regarding this matter and if necessary will have our representative call on you.

Yours very truly,

AMERICAN TRANSFORMER COMPANY

GCC:VS

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BULLETIN 1065

AmerTran Radio Products

Standards of Excellence for Radio Reproduction

AmerTran Audio Transformers

AmerTran De Luxe

The standard of excellence for audio amplification. The approach to ideal amplification with AmerTran De Luxe audio systems is so close that any further improvement which might be revealed by sensitive laboratory instruments could not be detected by the ear with the best existing commercial acoustical devices. Made in two types, the first stage, turn ratio 3; the second stage, turn ratio 4; completely shielded and sealed in with a weatherproof compound. High permeability alloy used in the cores. *Approximate shipping weight, 1½ lbs. List price, each, $10.00.*

Input Type 161

is an interstage audio transformer similar to the 2nd Stage AmerTran De Luxe except that its secondary has a carefully balanced center tap, and the maximum turn ratio is 5 (full secondary). Ratio of primary to each half of secondary 2½. It can be used preceding any type of power tube. The frequency characteristic is slightly flatter than that of the second stage AmerTran De Luxe when connected for 2½ to 1 turn ratio. *Approximate shipping weight 2 lbs. List price, each, $15.00.*

Output Type 182 (Impedance Ratio 4:1)

is designed to work out of UX 210 tubes, or tubes of similar plate impedance, into a speaker having approximately the impedance of W. E. type 640 AW cone, Brownlag-Drake, Pierard and similar speakers. The primary winding has a carefully balanced center tap. *Approximate shipping weight 2 lbs. List price, each, $15.00.*

Output Type 271 (Impedance Ratio 2:1)

is designed to work out of UX 171, or tubes of similar plate impedance, into a speaker having approximately the impedance of a WE type 640 AW Cone. The primary has a carefully balanced center tap. *Approximate shipping weight 2 lbs. List price, each, $15.00.*

Output Type 200 (Impedance Ratio 2000:1)

The primary of this output transformer is identical with that in type 182, and designed to work out of UX 210 tubes, or tubes of similar impedance. The secondary is designed for connecting directly to the moving coil of dynamic type speakers, such as the Jensen, Magnavox, etc. *Approximate shipping weight 2 lbs. List price, each, $15.00.*

Output Type 262 (Impedance Ratio 530:1)

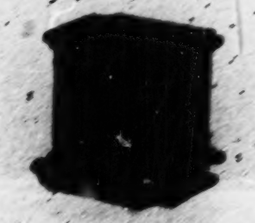
Designed to work out of 171 tubes into the moving coil of dynamic type loud speakers. The center tapped primary on this transformer is similar to the primary of type 271. *Approximate shipping weight 2 lbs. List price, each, $15.00.*

Output Type 678 (Impedance ratio 480-160-120-33.7)

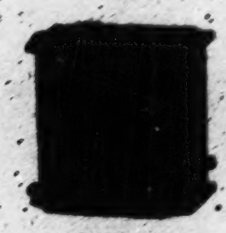
This has a center tapped primary suitable for working out of two 250 tubes; 75 ma. current capacity each half of primary. Secondary contains two separate 15 ohm coils and one 45 ohm coil, providing suitable combinations for 1, 2, 3, 4, 5, 6, 7, 8 or 9 dynamic speakers, or all in series for 200 ohm line. Shielded magnetically within a cast aluminum case. *Approximate shipping weight, 5 lbs. List price, $25.00.*

Intermediate Type 710 (Turn ratio 1¼)

This transformer has sandwiched primary and secondary coil sections with a carefully balanced center tap in both primary and secondary. It may be used between two pairs of push-pull tubes. It is carefully shielded magnetically within a cast aluminum case. *Approximate shipping weight, 4 lbs. List price, $20.00*



AmerTran De Luxe



Input or Output Transformer



Type 710 or Type 678

AmerTran Audio Transformers—*continued*

Equalizer Type 250

is designed to adjust the impedance of an electric phonograph pickup to the primary impedance of the 1st stage AmerTran De Luxe. Three primary taps are provided to compensate for slight variations in the impedance of the best available electrical pickups. Approximate shipping weight 2 lbs. List price, each, $10.00.



Equalizer Type 250

AmerTran Power Transformers

Type PF 52-A

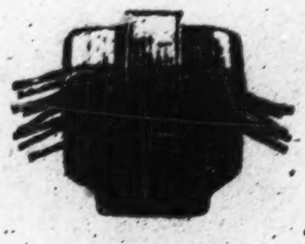
For D.C. output of approximately 450 volts, 100 ma. half wave with UX 281 or 220 volts, 100 ma. full wave, with UX 280. Two center tapped filament windings, 7½ volts each.

This new power transformer replaces both the PF 64 and the famous PF 52. It is similar to PF 52 except that the plate winding has been extended to 600 volts A. C. and provided with a center tap (300 volts each side of tap). This winding will safely carry from 200 to 120 ma. continuously, either when operating half wave with UX 281 or full wave with UX 280. Two filament windings, 7½ volts 2½ amperes each, have center taps. When used with lower voltage tubes suitable rheostats must be provided to lower the filament voltages. Primary 50 or 60 cycles tapped for 100, 110, 115, 120 volts. Not provided with switch, cord or plug. Approximate shipping weight 10 lbs. *List price*, each, $12.00.

Type PF-281

For D. C. output of 425 to 650 volts, 110 ma., with UX 281 half wave rectifying tube—Power tube UX 210. Heater windings for A. C. tubes.

This is a power transformer for half wave rectification with a UX 281 rectifying tube, to be used on 50 or 60 cycle, 110 volt circuits. It is rated 150 V. A. continuous load and has a plate winding for 720 volts A. C. maximum, 110 milliamperes, with a tap at 350 volts. There are four filament windings, one for 7½ volts with a center tap for the UX 281 rectifying tube; one for 7½ volts, 2½ amperes center tapped for use with one or two UX 210 power tubes; one for 1½ volts, 10 amperes without center tap for the filaments of UX 226 A. C. tubes; one for 2½ volts, center tapped for the filaments of UY 227 A. C. tubes. There is a copper ground shield over the primary, and primary taps are brought out for 100, 110, 115 and 120 volts. *This transformer virtually becomes an A-B-C eliminator when used with A. C. tubes and the proper filter circuit for D.C. voltages of from 425 to 650 volts, plate current 110 milliamperes.* Approximate shipping weight, 25 lbs. *List price*, $25.00.



AmerTran Power Transformer

Type PF-280

For D. C. output of 400 to 450 volts, 200 ma., with two UX 281 rectifying tubes, full wave—Power tubes UX 250 single or push pull.

This power transformer is for full wave rectification with two UX 281 rectifying tubes, having a 1200 volt A. C. plate winding with a center tap (600 volts each side of tap). Current capacity of plate winding 100-200 ma. Each of the two 7½ volt center tapped filament windings are sufficient for two UX 281 or two UX 250 tubes with their filaments in parallel. Primary 50 or 60 cycles tapped for 100, 110, 115 and 120 volts. Approximate shipping weight, 27 lbs. *List price*, each, $30.00.

Type H-67 Heater Transformer for A. C. Tubes

Filament supply for UX-226, UY 227, Kellogg A. C. tubes and UX 171.

This transformer has a rating of 40 V. A., for use on 50 or 60 cycle, 110 volt circuits. It has a copper ground shield over the primary, and there are three separate heater windings, each with a center tap; one for 1½ volts with sufficient capacity for the filaments of 6 UX 226 A. C. tubes; one for 2½ volts sufficient for 4 UY 227 A. C. tubes or 5 Kellogg A. C. tubes; and one 5-volt winding for the filaments of one or two UX 171 tubes. Primary tap voltages, 100, 110, 115 and 120. *The H-67, when used with the A. C. tubes specified, is virtually an "A" eliminator.* Approximate shipping weight, 9 lbs. *List price*, $12.00.



Heater Transformer Type H-67

AmerTran Choke Coils

AmerChoke Type 418

2 amperes, ¼ Henry, D. C. Resistance, 0.5 ohms.

This is a filter choke having a current capacity of 2 amperes and an inductance of approximately ¼ Henry when loaded. D. C. Resistance is approximately 0.5 ohms. It is intended primarily for use in "A" eliminator circuits and for removing the commutator ripple from D. C. circuits. Approximate shipping weight, 5 lbs. *List price,* $6.00

AmerChoke Type 854

60ma., 50 Henries, D. C. Resistance, 600 ohms.

This is a filter choke having a current capacity of 60 milliamperes and an inductance of approximately 50 Henries when loaded, depending on the core gap setting. D. C. Resistance is approximately 600 ohms. It is intended primarily for use in filter circuits of "B" eliminators and as an output choke for the loud speaker. The two gaps in the magnetic circuit are semi-adjustable for obtaining maximum inductance for various loads. Approximate shipping weight, 5 lbs. *List price,* $6.00

AmerChoke Type 709

120 ma., 15 to 20 Henries, D. C. Resistance, 210 ohms.

This is a filter choke having a current capacity of 120 milliamperes and an inductance of from 15 to 20 Henries when loaded. D. C. Resistance is approximately 210 ohms. It is recommended for use in any filter circuit requiring more than 60 milliamperes load. In construction it is similar to the Type 854. Approximate shipping weight, 5½ lbs. *List price,* $6.00

AmerChoke Type 857 (Filter)

250 ma., 20 Henries, D.C. Resistance 110 ohms.

A heavy duty choke of high inductance for use in filter circuits passing up to 300 ma., D.C. It is recommended for circuits in which the D.C. current exceeds the limits of the type 709 up to 300 ma. Approximate shipping weight, 14 lbs. *List price,* $12.00.

AmerChoke Type 641 (Output Only)

400 Hy. full winding, each half 60 ma. 275 ohms D.C.

This is an audio output impedance with center tap designed to take the plate current of two 250 tubes or smaller power tubes. It contains four sandwiched coil sections arranged and connected for absolute electrical symmetry on both sides of the center tap. Current capacity 60 milliamperes each side of center tap. Mounted in metal case sealed with insulating compound. Five terminal posts on bakelite cover. Approximates shipping weight 6 lbs. *List price,* $10.00.

AmerChoke Type 161 (Output or Filter)

60 ma., 40 Henries, D.C. Resistance 275 ohms.

This output choke coil is intended for the plate circuit of a single 250 or smaller power tube and has a flat audio frequency characteristic from 40 to 9,000 cycles. It may also be used as a filter choke. Approximate shipping weight, 6 lbs. *List price,* $10.00.

AmerTran Resistors (Voltage Dividers)

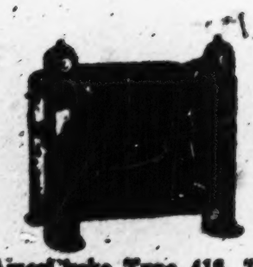
Type 400

Plate voltage tapped potentiometer.

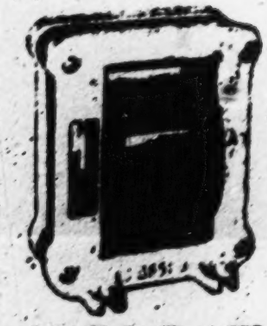
This is a wire-wound double-tube resistor for use across the output of 400 volt filter circuits and is provided with taps conveniently arranged for obtaining practically all intermediate plate voltages below the maximum. Approximate shipping weight, 1 lb. *List price,* $7.50.

Type 500 AmerTran Dual Adjustat

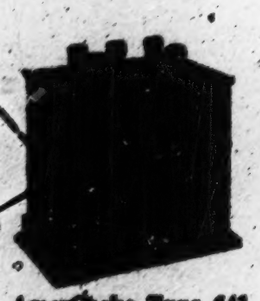
This voltage divider has a total resistance of approximately 41,000 ohms—with fixed terminals at 0, 6,000, 31,000, and 41,000 ohms. In addition there are two rotary switch blades which provide 2 variable plate voltages in 15 steps from 6,000 to 31,000 ohms each. Approximate shipping weight, 1¼ lbs. *List price,* $8.50.



AmerChoke Type 418, 709, or 854



AmerChoke Type 857



AmerChoke Type 641



AmerTran Resistor Type 400



AmerTran Dual Adjustat Type 500

AmerTran Line Adjusting Transformers

Type 976 Auto Transformer (Converts 220 Volt A.C. to 110 V.A.C.)

200 V.A. capacity, 50 or 60 cycles, 110-220 volts.

In many localities the house lighting circuits are 220 to 230 volts. Type 976 steps this voltage down to 110-115 volts with ample capacity for the largest 110-115 volt A. C. operated receivers and eliminators. Approximate shipping weight 10 lbs. *List price*, each, $20.00.

Licensed AmerTran Power Devices*

Push-Pull Power Stage Type P— (Power Stage Only)

Push-Pull Input and Output transformers, power tube sockets with grid resistance wired and mounted on a metal base.

The Type P— AmerTran power stage consists of a Type 151 Input and either a Type 152, 271, 200, or 262 Output transformer (depending upon the combination of power tubes and speaker desired) mounted on a metal base and wired to two power tube sockets with necessary 50,000 ohm resistances in the C— lead. Licensed under patents owned or controlled by the Radio Corporation of America and sold with or without RCA or Cunningham tubes. Approximate shipping weight, 10 lbs. *List price*, east of Rocky Mountains, without tubes, $36.00

AmerTran Push-Pull Amplifier Type 2AP

A complete two stage audio amplifier with first stage AmerTran De Luxe and second stage AmerTran Push-Pull for two power tubes. Designed to use one UY 227 A. C. tube in the first stage and two 171 or two 210 power tubes in the push-pull stage. Licensed under patents owned or controlled by the Radio Corporation of America and sold with or without RCA or Cunningham tubes. Approximate shipping weight, 20 lbs. *List price*, east of Rocky Mountains, less tubes, $60.00.

AmerTran ABC Hi-Power Box Type 21-D

500 volts D. C. plate and lower tap voltages, plate currents up to 100 ma.; A. C. filament current for a 281 rectifier, two 210 power tubes and several 226 and 227 A. C. tubes. Adjustable negative bias voltages for all tubes. Licensed under patents owned or controlled by the Radio Corporation of America and sold with or without rectifying tube. Approximate shipping weight, 50 lbs. *List price*, east of Rocky Mountains, less tubes, $95.00.

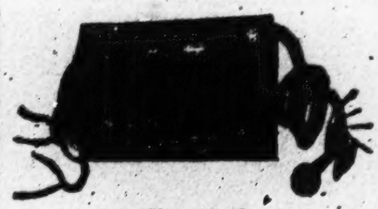
AmerTran Concert Hall Type Amplifier—Type 25A

This is a powerful reproducer of the switchboard type intended for use with a quantity of loud speakers in auditoriums, theatres, churches and open air amusement resorts. It can be adapted for working out of a detector tube, 200 ohm line or any circuit the impedance of which is known, and the output can be adjusted for from one to nine dynamic speakers, a 200 ohm line or for high impedance speakers, all at full volume. It combines a three stage double push-pull audio amplifier and power supply mounted on the rear of a vertical metal panel 5 ft. high and 21 in. wide, supported at the sides with 3 in. channels. It is operated completely from the 110 volt, 60 cycle lighting circuit and in addition to furnishing power for the amplifier, provides additional B, C and heater voltages for the usual radio tuner. The UX-250 or CX-350 power tubes in the last push-pull stage provide an undistorted power output of approximately 12 watts at full load and the frequency characteristic is substantially flat over the entire audio range. This apparatus is licensed under patents owned or controlled by the Radio Corporation of America. Prices on application stating input and output requirements.

*Licensed Devices Are Not Subject to Same Discount As Other Parts Listed in This Bulletin.



Type P—
Push Pull Power Stage



Type 2AP
2 Stage Push Pull
Power Amplifier



Type 21-D
ABC Hi-Power Box

American Transformer Company
178 Emmet Street Newark, N. J.

PRINTED IN U. S. A.

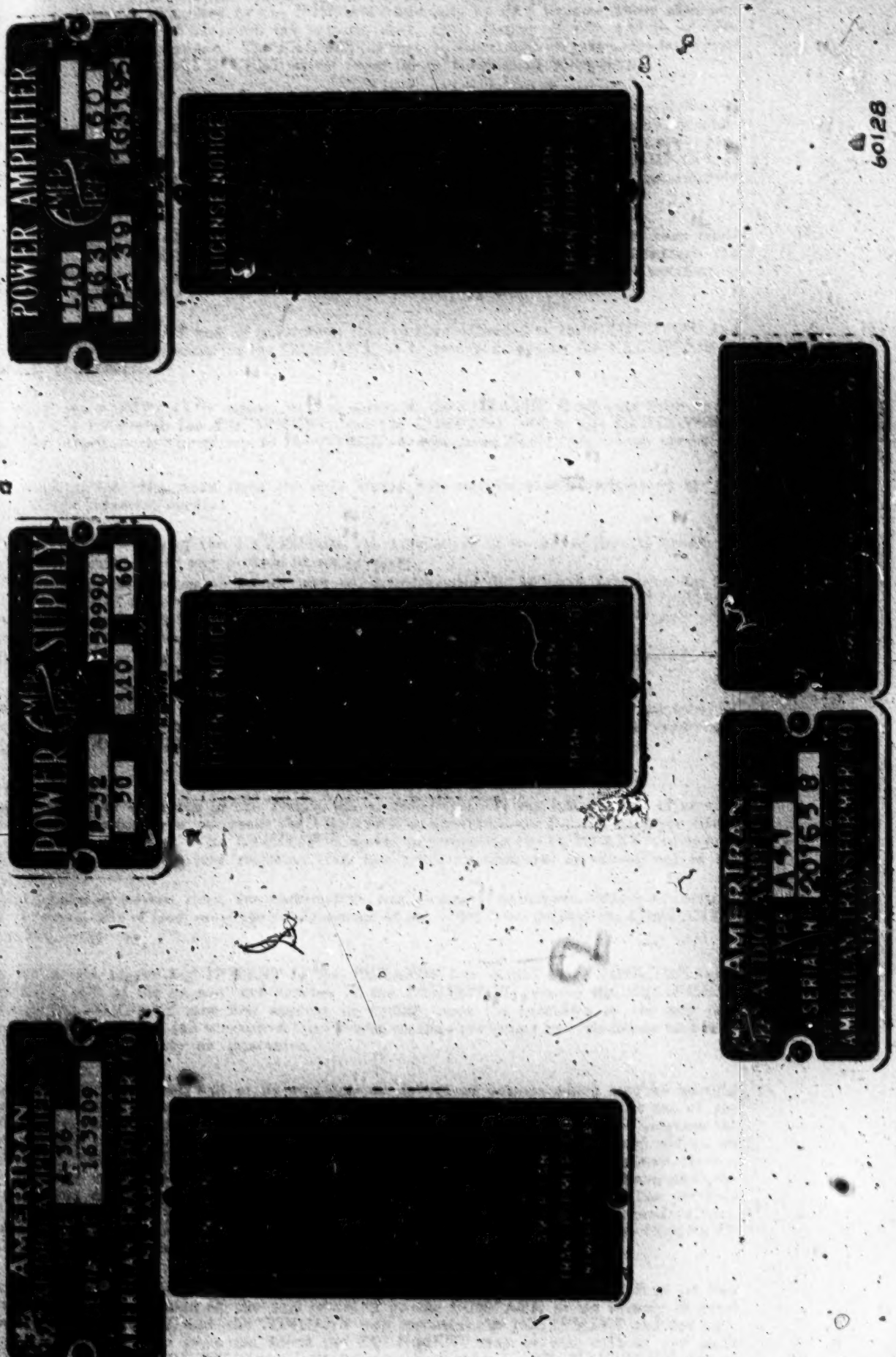
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PLAINTIFF'S EXHIBIT No. 34

Photograph of the License Notice Plates attached to the defendant's amplifiers



PLAINTIFF'S EXHIBIT No. 25

Defendant's Contract with Strand Theatre Company of Allentown, Pennsylvania

Agreement made the 20th day of February 1928, between GENERAL TALKING PICTURES CORPORATION of 218 West 42nd Street, Manhattan, New York City (hereinafter called the COMPANY) and STRAND THEATRE COMPANY of ALLENTOWN, Pa. (hereinafter called the EXHIBITOR).

In consideration of the terms, conditions and covenants herein contained the parties hereto mutually agree as follows:

1.- The COMPANY hereby grants to the EXHIBITOR a personal, non-exclusive, indivisible license to use in the STRAND Theatre [illegible] in the City of ALLENTOWN State of PENNSYLVANIA (hereinafter called the THEATRE), the equipment described in paragraph 2 hereof (hereinafter called the EQUIPMENT) for the reproduction of sound in connection with the exhibition of motion pictures, under the patent rights now or during the term hereof controlled by the Company or with respect to which it shall have the right to grant such license.

2.—The EQUIPMENT to be installed in one booth with two (2) Simplex Projectors equipped with ½ H. P. motors to be furnished by the EXHIBITOR and consists of:

(A) Two (2) Photoflex sound reproducing heads.
(B) Two (2) preliminary amplifiers and tube panel.
(C) One (1) "B" amplifier and power supply unit.
(D) One (1) set of head speakers.
(E) Tubes necessary to complete installation.

3.—The COMPANY shall install the EQUIPMENT in the THEATRE and will use its best efforts to complete the installation on or about the 30th day of MARCH 1928

4.—The EXHIBITOR at its own cost and expense

(A) Shall make any changes and alterations which may in the Company may direct for the proper installation and operation of the EQUIPMENT and for such purposes shall furnish all power the COMPANY may require, do all wiring and provide all current, outlets, plugs, switch and other connections, and

(B) Shall comply with the terms hereof, comply with all statutes, ordinances and regulations of any State, Municipal or local authority and of any Insurance or Board of Fire Underwriters, relating to the subject matter hereof.

5.—The EXHIBITOR shall make the following payments pursuant to the COMPANY:

A—Simon Pure [illegible] Dollars ($[illegible]) on or before the execution of this agreement, receipt whereof is hereby acknowledged, [illegible] Dollars ($[illegible]) when EQUIPMENT is ready for shipment to the [illegible] and [illegible] ($[illegible]) equal consecutive monthly installments of [illegible] each, on the 1st of every month, [illegible] 1928, evidenced by the promissory [illegible] of the EXHIBITOR, [illegible] date of the [illegible] and in the [illegible] bearing [illegible] per cent. ([illegible]%) interest per annum, payable monthly, and at the option of the holder or owner thereof, all [illegible] of any [illegible] or other sums or sums payable or to be paid under this agreement; and fifty [illegible] Dollars ($[illegible]) during the [illegible] next [illegible], the first payment commencing one (1) year from the date hereof.

[illegible] of each [illegible] ($[illegible]) thereof, upon completion thereof, each and [illegible] of [illegible] Dollars ($[illegible]) [illegible] Dollars ($[illegible]) [illegible] Dollars ($[illegible])

that in any such event the rights will be similar for damages or payment of such renewal or otherwise, and that it will hold and save harmless the COMPANY from and against any and all claims for any portion thereof or growth thereon, or arising out of the agreement by the parties of the amount of damages or payment of any such renewal or growth to be paid by the EXHIBITOR pursuant to the agreement, the provisions for removing of any tree of the option of the COMPANY hereinbefore given to the COMPANY, and in particular to hold and pay the COMPANY also all attorney's fees and other expenses incurred in the premises thereof.

[illegible] hereby consents and shall be construed to conferring upon the EXHIBITOR an exclusive license to operate the [illegible] in any place or on premises or part leasing the COMPANY from including and granting herein for the use of the EXHIBITOR in connection therewith.

10.—This agreement shall cover to the benefit of the successors and assigns of the COMPANY but neither the agreement nor the EXHIBITOR shall be assigned, mortgaged, pledged or otherwise disposed of by the EXHIBITOR without the written consent of the COMPANY.

11.—This agreement shall be construed in accordance with the laws of the State of New York.

12.—THE THEATRE is hereby permitted to operate its present turntable system known as the RICHMOND with the projection machine on which the DE FOREST PHONOFILM attachment is added and to keep on and maintain such turntable, which connection shall be made by and at the expense of the EXHIBITOR.

IN WITNESS WHEREOF, the parties hereto have duly executed and sealed these presents the day and year first above written.

IN THE PRESENCE OF:

GENERAL TALKING PICTURES CORPORATION

By ..... [L. S.]

STRAND THEATRE COMPANY

By ..... [L. S.]

[illegible] [L. S.]

[3]

STATE OF NEW YORK, COUNTY OF NEW YORK } ss.:

On this ... day of ... 1930, before me came ... JOSEPH STARK ... to me known, who, being by me duly sworn, did depose and say that he resides at the City of New York; that he is the ... of GENERAL TALKING PICTURES CORPORATION, the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was affixed by order of the Board of Directors of said corporation; and that he signed his name thereto by like order.

Notary Public
New York County Clerk's No. [illegible]
New York County Clerk's No. [illegible]
Commission expires
May 5 1930

PENNSYLVANIA

STATE OF [illegible] } ss.:

On this 5th day of FEBRUARY 1930, before me came H. STUDEBAKER to me known, who being by me duly sworn, did depose and say that he resides at Allentown, Pa.; that he is the PRESIDENT of STRAND THEATRE COMPANY, the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was affixed by order of the Board of Directors of said corporation; and that he signed his name thereto by like order.

Joseph B. Gaffney
ALDERMAN 4th WARD
My Commission Expires
on Monday in Jan. 1932.

STATE OF NEW YORK, COUNTY OF NEW YORK } ss.:

On this ... day of ... 1930, before me came ... to me known and known to me to be the individual described in and who executed the foregoing instrument and he duly acknowledged to me that he executed the same.

[illegible]

[4]

Dated FEBRUARY 20th, 1930

[illegible]

and

[illegible]

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PLAINTIFF S' EXHIBIT No. 38

738

H. DE F. ARNOLD.

METHOD OF REPRODUCING ELECTRICAL VARIATIONS.

APPLICATION FILED OCT. 5, 1912.

1,118,172. Patented Nov. 24, 1914

Fig. 1

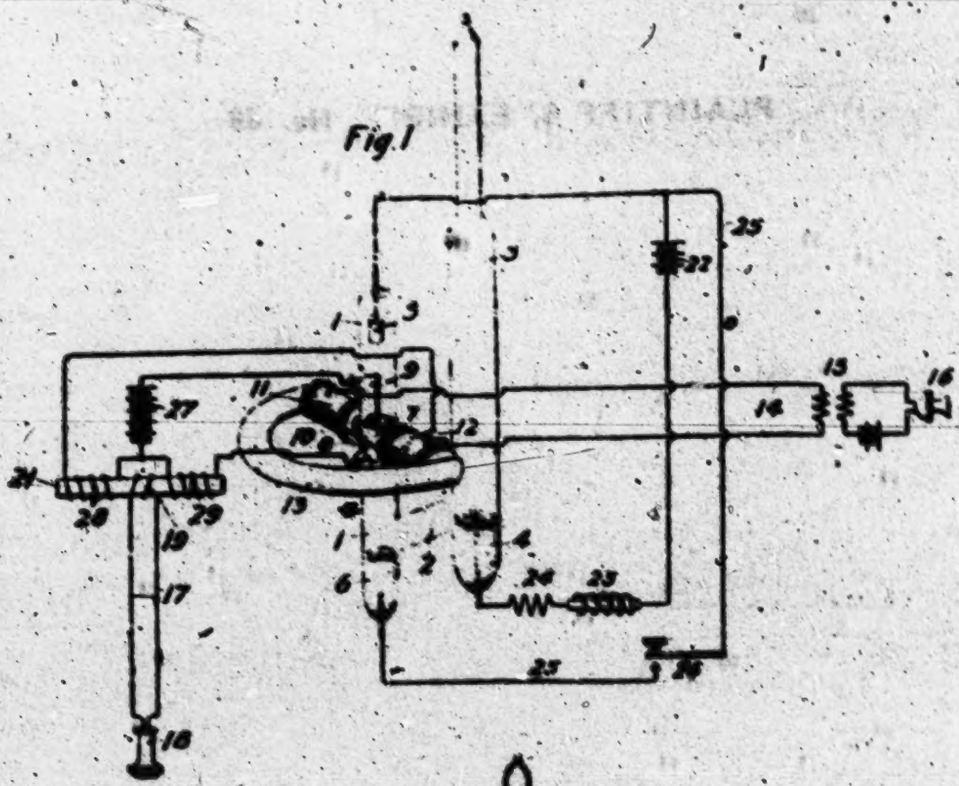
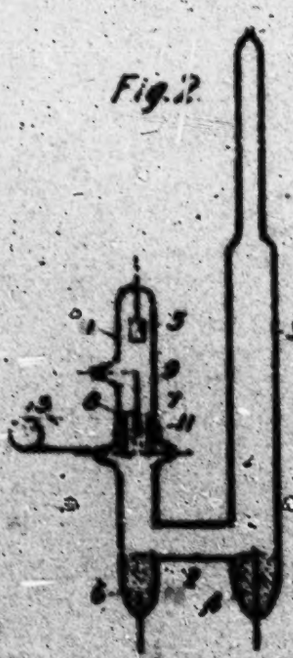


Fig. 2



Witnesses:
Otto Klotz
W. F. Hoffman.

Inventor:
Harold De F. Arnold.
by John B. Roberts
Atty.

UNITED STATES PATENT OFFICE.

HAROLD DE FOREST ARNOLD, OF BELLEVILLE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

METHOD OF REPRODUCING ELECTRICAL VARIATIONS.

1,118,172. Specification of Letters Patent. Patented Nov. 24, 1914.

Application filed July 15, 1908. Serial No. 443,643.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at Belleville, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Methods of Reproducing Electrical Variations, of which the following is a full, clear, concise, and exact description.

This invention relates to the art of reproducing electric variations; its objects are to secure simplified reproduction of variations of current energy, reproduction without distortion, sensitiveness to minute currents, efficiency, reliability, and noiseless operation.

Among other uses the invention is applicable to telephony, for the purpose of obtaining in an outgoing circuit an amplification of voice currents originating in an incoming circuit.

It is also applicable to telegraphy, and signaling systems generally where amplification is desirable in receiving, recording or reproducing impulses of electrical energy.

In carrying out the invention use is made of the principle of deflection by an electromagnet or other suitable means of an ionized stream which may be produced in any of a number of ways. The mercury arc has been found to be a suitable agent for the purpose. The current variations to be reproduced or reinforced may be impressed on the coils of an electromagnet so situated that the variations of magnetism induced therein produce corresponding deflections of the ionized stream. The invention does not depend upon any effect in current flow which such deflecting may have on the circuit of the ionized stream but involves a novel method, which will now be explained, of detecting and utilizing the variations produced by the deflecting agent.

The detecting means of this invention involves the use of an auxiliary circuit which is non-existing in character and independent of the circuit for establishing the ionized stream, except that it intercepts a portion of the output of the stream. This auxiliary circuit is maintained by means of an auxiliary cathode or pair of such cathodes immersed in the stream and connected to a source of electro-motive force which may be separate and distinct from the source producing the stream itself, the circuit being completed through an anode which may likewise be immersed in the stream. There is thus established in the vicinity of the auxiliary cathode or cathodes an electrical field, which exerts in the auxiliary circuit a flow of current the intensity of which is directly dependent upon the distribution of ionization in the auxiliary cathode field.

The invention will be more fully understood by reference to the accompanying drawings wherein Figure 1 shows a system of circuits and apparatus by which the method hereinafter claimed may be carried out and Fig. 2 shows in elevation and cross section the apparatus of Fig. 1 separated from the circuits.

Referring to the drawings, the means for producing the ionized stream, which in this instance I have shown as a mercury arc apparatus, comprises a main chamber 1 with a horizontal branch 2 and a condensing chamber 3 together with a mercury cathode 4, an anode 5 of carbon or other suitable material, and a starting mercury anode 6, supported within the main chamber 1 are a pair of auxiliary cathodes 7, 8 which are shown semi-cylindrical in form and slidably separated from each other and from the walls of the chamber. Extending downwardly between the auxiliary cathodes is an auxiliary anode 9. The auxiliary cathodes and the auxiliary anode may be of platinum, or other suitable conducting material. Leading-in conductors preferably of platinum wire are provided for the several electrodes of the device.

As the means for deflecting the ionized stream, I have shown an electro-magnet 10, the means of support of which is not shown. Each magnet comprises a pair of coils 11, 12, surrounding inwardly extending pole pieces the outer ends of which are joined by a semi-circular yoke 13. The pole pieces present their faces in opposite sides of the main chamber 1 in the region of auxiliary cathodes 7, 8 so that the lines of force between the pole pieces are in a direction transverse to the direction of flow of the ionized stream in the chamber 1 and operate to deflect the stream in the direction of one auxiliary cathode or the other, according to the direction of the current in the magnet coils.

The system shown in Fig. 1 comprises five circuits—(1) an incoming circuit 14 including the coils 11, 12 of the electromagnet 10 and the secondary of an induction coil 15, the primary of which is in (2) a local circuit containing a source of current and a transmitting device such as the telephone transmitter 16; (3) an outgoing circuit 17 including a receiving device such as the telephone receiver 18 and the secondary winding 19 of a transformer 21; (4) an energizing circuit for the mercury arc comprising a battery 22, impedance coil 23 and resistance coil 24, this circuit being connected, one terminal to the anode 3 and the other terminal to the cathode 4, and having a starting branch 25 connected, one terminal to the battery 22 and the other to the starting anode 6 and including a starting key 26; and finally (5) the auxiliary detecting circuit including a battery 27, one terminal of which is connected to the auxiliary anode 9 and the other branching through balanced primary windings 28 and 29 of the transformer 21 to the auxiliary cathodes 7 and 8 respectively.

The impedance coil 23 and resistance coil 24 provide a balance for the mercury arc circuits to maintain a steady flow of current therein which, when once established as by tipping the tube, closing the circuit at the starting key 26 over the path 22, 23, 24, 4, 3, 6, 25, 26, 22 and then releasing the key 26 is maintained automatically over the path 22, 23, 24, 4, 3, 1, 4, 22 which includes the ionized arc stream in the main chamber 1. This stream passes by and in contact with the auxiliary cathodes 7 and 8, filling the region between them, and rendering the auxiliary circuit conductive so that current flows from the battery 27 dividing through the primary windings 28 and 29 of the transformer 21 to the auxiliary cathodes 7 and 8, as and through the ionized vapor therebetween and by way of the auxiliary anode 9 back to the battery 27. It is noteworthy of this auxiliary circuit that it is open-arcing in character and that the potential difference existing between the auxiliary electrodes is independent of, and in fact may be very much greater than, that existing between the electrodes of the arc stream. At the same time the current flow in the auxiliary circuit may be very much less than that in the arc circuit. For example, in one particular embodiment of the apparatus the potential difference existing between the auxiliary anode 9 and the auxiliary cathodes 7 and 8 was 100 volts whereas that between the anode 3 and cathode 4 of the arc was 20 volts. The current flow in this instance was .01 ampere in the auxiliary circuit and one ampere in the arc circuit. The primary coils 28, 29 of the transformer 21 are wound differentially in the auxiliary circuit, that is to say, in such a direction with respect to each other that the core thereof under normal conditions of the circuit is not magnetized. The normal current flows equally or approximately so in the two branches, this being due to the symmetrical arrangement of the auxiliary cathodes 7, 8 with respect to the ionized vapor in the space between them. When, however, the electromagnet 10 is energized by current received over the incoming circuit, 14, a magnetic field is produced which deflects the stream toward one electrode or the other. The effect of this is a change in the distribution of ionization in the field or region adjacent the auxiliary cathodes and current will flow with increased strength through one primary winding of the transformer and with decreased strength through the other thereby inducing current in the secondary winding which is transmitted over the outgoing circuit 17 and recorded or made manifest in the receiving instrument 18. In this manner minute variations of current energy such as those transmitted over great distances by a telephone or signaling device and delivered to the instrument by the incoming circuit 14 are reproduced and amplified in the outgoing circuit 17. The extremely small mass of the ionized vapor which is deflected by the electromagnet enables the reproduction of current variations to be accomplished without distortion. By reason of the non-arcing character of the detecting circuit the relaying of current variations is accomplished without disturbing or "noisy" currents in the outgoing circuit, this being of especial importance in telephone transmission systems.

I have illustrated and described two auxiliary cathodes and a branched circuit through balanced primary windings 28 and 29, for the reason that I have found that such arrangement produces the best results. My fundamental invention would, however, be embodied in an arrangement in which only one auxiliary cathode and one primary winding are employed. Also the auxiliary anode 9 may be omitted and the battery 27 may be connected with the anode 3, without departing from the spirit of my invention. Moreover, while I prefer to use two magnet coils 11 and 12, one of them may be omitted, and indeed, the arc stream may be caused to be deflected by electro-static instead of electromagnetic means.

I claim:

1. The method of reproducing electrical variations which consists in establishing an ionized stream, maintaining a circuit including a transverse path within said stream, applying at a point within said path a variable deflecting force to said stream, and producing thereby current variations in the said circuit.

3. The method of reproducing electrical variations which consists in establishing an arc, maintaining an auxiliary non-arcing circuit in a transverse path within said arc, applying at a point within said path a variable deflecting force to said arc, and producing thereby current variations in said auxiliary circuit.

4. The method of reproducing electrical variations which consists in establishing an ionized arc stream, maintaining an auxiliary non-arcing circuit including a transverse path within said stream, impressing at a point within said path a variable deflecting force to said stream and producing thereby current variations in the said auxiliary circuit.

5. The method of reproducing electrical variations which consists in establishing an ionized stream, maintaining a balanced non-arcing circuit having two paths through a portion of the luminous vapor of said stream, deflecting said stream to and fro between said paths in accordance with current variations in an incoming circuit, and transmitting in an outgoing circuit the current variations thereby produced in the balanced circuit.

In witness whereof, I hereunto subscribe my name this 28th day of July, A. D., 1911.

HAROLD DE FOREST ARNOLD.

Witnesses:
Minnie V. Cleary,
Fred Dorman.

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2227

Plaintiffs' Exhibit No. 40.

[B2]

SUBSTITUTE LICENSE AGREEMENT

DATED JULY 1, 1932

BETWEEN

GENERAL ELECTRIC COMPANY

2228

AND

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AGREEMENT dated July 1, 1932, between GENERAL ELECTRIC COMPANY, a New York corporation (herein called the General Company), and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, a New York corporation (herein called the Telephone Company).

WHEREAS the parties hereto heretofore entered into an agreement made the first day of July, 1920, generally known as Agreement "B", which was subsequently modified by an agreement dated July 1, 1926, generally known as "Modified Agreement B", and 2229

WHEREAS it is now the mutual desire of the parties to substitute therefor this agreement and the licenses herein granted.

Now, in consideration of the premises and the mutual agreements herein contained, the parties agree each with the other as follows:

ARTICLE I.

Termination of Existing Agreements and Licenses.

The said agreements of July 1, 1920, and July 1, 1926, generally known as Agreement B and Modified Agreement B, respectively, and all licenses therein granted and agreed to be granted are hereby terminated as of the date hereof, and
2231 this agreement and the licenses herein granted and agreed to be granted are substituted therefor.

ARTICLE II.

Definitions.

For the purposes of this agreement the following terms are defined as follows:

"Wire telephony" is the art of communicat-
2232 ing or reproducing sound waves (created, directly or indirectly, by the voice or by musical instruments) by means of electricity, magnetism or electro-magnetic waves, variations or impulses conveyed or guided by wires, and includes all generating, measuring, switching, signaling and other means or methods incidental to or involved in such communication.

"Wireless telephony" has the same meaning as "wire telephony", except that the waves, variations or impulses are radiated through space.

"Wire telegraphy" is the art of communicating messages by code signals (such as the Morse Code, for example) and of picture transmission, by means of electricity, magnetism or electro-magnetic waves, variations or impulses conveyed or guided by wires, and includes all generating, measuring, switching, signaling and other means or methods incidental to or involved in such communication, but does not include such devices as annunciators, elevator signals, engine room telegraphs, etc. 2234

"Wireless telegraphy" has the same meaning as "wire telegraphy," except that the waves, variations or impulses are radiated through space.

"Picture transmission" is the art of transmitting, or receiving at another point than the point of transmission, by means of electricity, magnetism or electro-magnetic waves, variations or impulses, the aspect or shape of things, including pictures, whether still or moving, drawings, writings, forms and other graphic, printed and written matter of all kinds; and includes television. 2235

"Programs" means pictures, news, music, speeches, sermons, advertising and entertainment, educational and similar matter, or any of them or combinations of any of them, for the purpose of exhibition, entertainment or instruction.

"Power purposes" means all prime movers and their accessories and all generation, use,

measurement, control and application of electricity for light, heat, power and traction, but does not include any communication purpose.

"*Public address system*" means a combination including one or more telephone transmitters, an electrical amplifier or amplifiers and one or more loud speaking telephone receivers, either adjacent to said transmitters or at a distance therefrom, operating by one-way wire
2237 telephony for the reproduction of sound with increased volume, but does not include apparatus for (1) wireless telephone reception, or (2) reception of programs over electric light, electric heat, electric power or electric traction lines, or (3) the production or reproduction of sound from sound records.

"*Phonographs*" means all apparatus for the reproduction of sound from sound records used in or in connection with such apparatus, to be heard in the immediate vicinity of the apparatus, but does not include apparatus for the trans-
2238 mission to, or reception at, other points of sound reproduced from such records.

"*Electric Phonograph*" means a phonograph in which the sound record used therein gives rise to or controls an electric current or electromotive force in such a way that the variations of the electric current or electromotive force correspond in some way to the recorded sounds, and the electric current or electromotive force directly or indirectly brings about the production of the sound from the phonograph.

"*Transoceanic*" communication means all communications which crosses any ocean, gulf or

sea between two continents, or between a continent and an island more than one hundred miles from its shores (islands within one hundred miles of the shores of a continent being considered parts thereof); or between two islands which are not parts of the same continent, except that communication between ships or aircraft, between ships and aircraft, or between ships or aircraft and shore, and communication between parts of the same continent, is not transoceanic communication. North America, including the 2240
Panama Canal Zone and all of Central America north thereof, is to be considered as one continent, and South America and all of Central America south of the Panama Canal Zone as another.

"The United States Government" means not only the Federal Government but also the Governments of the Philippines, Porto Rico and other federal possessions, present or future; but does not include any municipal, county or state government. 2241

"Train dispatching" is telegraphic or telephonic conveyance of train orders or operating information between the office of a train dispatcher or similar official and railway trains or other automotive land vehicles (not including airplanes or airships) or points along the line of way, for directing the movements of such automotive vehicles.

"Railway signalling" is the operation of signals, switches, brakes, stops, crossing gates, etc., controlling or signalling the movements of trains

or other automotive vehicles, controlled by or in accordance with train or vehicle movements or track conditions, including block signaling, cab signals and train stops. It does not include train dispatching.

"*Apparatus*" includes machines, devices and appliances and the materials entering into the construction thereof.

2243 "*Household devices*" are electric or electrically operated apparatus, not herein otherwise specified, designed primarily for domestic use, but do not include apparatus for communication purposes.

"*Homes*" means all places of residence, permanent or temporary, including, however, as to hotels, hospitals and club houses only the private living rooms thereof.

"*Amateur*" means one, not a professional investigator, who is more than a mere broadcast 2244 listener and who evidences his interest in the art of wireless telephony by study, investigation or experiment in the art.

"*Printing telegraph apparatus*" means, and is limited to, mechanisms and devices for use in telegraphy, whether wire or wireless, whereby electrical signals corresponding to the characters of a message

(a) are created in an electric circuit by the operation of a manual device upon which such characters are represented, or by the

operation of an automatic transmitter controlled by a tape or other record having holes or other marks corresponding respectively to the characters of the message impressed thereon by the operation of such manual device, and/or

(*b*) are utilized to cause said characters to be successively recorded or displayed (directly or through storage means) in typed or other form, or are utilized to select successively devices or elements corresponding to said characters, and/or 2246

(*c*) are sequentially distributed or delivered by the apparatus referred to in clause (*a*) to a transmission channel, (such as a wire circuit, carrier-current circuit, or radio apparatus) or from a transmission channel to the apparatus referred to in clause (*b*);

but this definition does not include the transmission channel or any apparatus, circuits, systems 2247
or methods for electrical transmission or reception the functions of which are distinct from those of the apparatus referred to in clauses (*a*), (*b*) or (*c*) hereof, nor any mechanism or devices for enabling automatic comparison of sequential repetition of said signals or records thereof; and this definition does not include any apparatus for "picture transmission" as herein defined.

"*Subsidiaries*" of either party are corporations a majority of whose stock having power to vote for the election of directors is owned, di-

rectly or indirectly, either by such party, or by such party and one or more of its other subsidiaries, or by one or more of its other subsidiaries. The party hereto so controlling, directly or indirectly, any subsidiary is herein called the "*parent company*" of such subsidiary.

"*Companies of the Bell System*" are those companies which, in connection directly or indirectly with the Telephone Company, provide a
2249 telephone service throughout the United States, or from the United States to foreign countries. These companies at present comprise the Telephone Company, Western Electric Company, Incorporated, Cuban American Telephone and Telegraph Company, and the so-called Associate Companies and Connecting Companies, and the several subsidiaries of each of said Companies.

Any dispute arising as to the meaning or application of the foregoing definitions shall be settled by arbitration, as hereinafter provided.

2250 ARTICLE III.

THE PATENTS INCLUDED IN THIS AGREEMENT.

The licenses provided for herein are granted and agreed to be granted under all patents, and rights to or under patents, of the United States now or hereafter during the term of this agreement owned or controlled by the parties hereto, and under all such patents hereafter issued upon inventions now or hereafter during said term so owned or controlled, and to the extent to which the parties have or may have the right to grant licenses, in so far as the inventions covered by

such patents are or shall be applicable to the respective fields for which said licenses are expressed as granted or to be granted, excepting (1) as otherwise specified in connection with the several grants hereinafter contained, and (2) such patents and inventions as may hereafter be excluded from the operation of this agreement in the following manner:

Each party agrees to furnish to the other, upon request, a list of all United States patents under which said other party is entitled to receive li- 2252
cense hereunder. Such lists shall separately identify those patents, and shall also include those applications as to which rights, if granted hereunder, would be restricted in scope or would involve continuing obligations not implied by law. Copies of all contracts creating such restrictions or obligations shall, upon request, be furnished by each party to the other. Thereupon, and within six months after the receipt of the lists to be furnished as aforesaid, each party may in writing advise the other as to the patents
and applications described in such list, furnished 2253
by the other, which (or the patents to issue on which) it desires to exclude from this agreement; and no licenses are granted by this agreement under any patents so excluded.

ARTICLE IV.

Scope of Licenses.

1. All of the licenses herein granted are, unless otherwise expressed in connection with the several grants, licenses to use methods and processes, and to make, use, sell, lease or otherwise

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dispose of apparatus and systems in the fields in which the licenses are granted.

2. A license to make apparatus includes a license to have such apparatus manufactured for the licensee by others, except that no rights are granted to either party to manufacture or to have manufactured, under patents under which it receives licenses hereunder, apparatus of the character at the time manufactured by the other
2255 party, except in factories owned or operated by one or the other of the parties hereto, or by their subsidiaries, without the written consent of the party granting such licenses.

3. Every license herein granted to either party includes, unless otherwise herein provided, all incidental rights necessary to the full enjoyment and exercise of the license granted, notwithstanding that such incidental rights may lie primarily in a field in which the said party is not herein expressly granted a license.

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4. The making, using, selling, leasing or otherwise disposing of parts is subject to the same restrictions and conditions as are applicable under this agreement to apparatus of which they are or may be parts.

ARTICLE V.

Reservations and Exceptions to Which the Licenses are Subject.

1. No licenses are granted by either party with reference to the manufacture or sale of wire or

able for the transmission of electric current for ght, heat, traction or other power purposes, or or telephone or telegraph purposes.

2. No licenses are granted to the Telephone ompany for electric lamps or other lighting pparatus (except non-exclusive licenses with eference to telephone and telegraph signal mps and telephone and telegraph ballast lamps or use solely in fields in which the Telephone ompany is otherwise licensed under this agree- 2258 ent).

3. The licenses herein granted to the Telephone ompany, in so far as they cover rights to sell lease carrier current, wireless or vacuum be apparatus for use on electric railroads, are nited to sales or leases of said apparatus to e railroads.

4. Wherever in this agreement either party re- ives from the other a license with the right to ens others, such party shall have the right to lease others for past infringement in the fields 2259 r which it receives such licenses and to retain r itself all considerations paid to it on account such past infringements.

ARTICLE VI.

Licenses Granted.

Subject to the foregoing reservations, each rty grants and agrees to grant to the other the llowing licenses in the following fields of use:

Government Uses.

Each party grants to the other non-exclusive enses to make for, and sell or lease to, the

United States Government wireless apparatus and systems.

2. Wireless Telegraphy.

(*a*) The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of wireless telegraphy for combined wireless telephone and telegraph sets
2261 for use on ships; except that where such combined sets are for use on ocean-going and coastwise ships of American registry (excluding harbor tug-boats and other harbor craft), said licenses are only to manufacture; and the Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, to use, lease or sell or otherwise dispose of, but not to manufacture such sets. The Telephone Company agrees, upon request, to make such sets and sell them for such use to the General Company upon
2262 reasonable terms.

(*b*) The General Company grants to the Telephone Company non-exclusive licenses in the field of wireless telegraphy to make and use (but not to sell, lease or otherwise dispose of, except to Companies of the Bell System) apparatus and systems for its own communication or that of Companies of the Bell System, and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement, but not for transmission of messages for the public except temporarily in emergencies due to storms or other catastrophes.

(*c*) The General Company grants to the Telephone Company non-exclusive licenses in the field of wireless telegraphy to make and use (but not to sell, lease or otherwise dispose of, except leases to subscribers in connection with a service given by Companies of the Bell System in this paragraph described) apparatus and systems for the purpose of giving within the continental United States, and between the continental United States and other parts of continental North America, a business, commercial or official 2264
service limited to a particular customer or class of customers and analogous to the service given by Companies of the Bell System by wire telegraphy at the date of this agreement, commonly designated as leased wire or special contract service, but said licenses do not include the making or using of such apparatus for (1) transmission or reception for the public generally or (2) transoceanic communication or (3) transmission or reception of programs.

(*d*) The General Company grants to the Telephone Company non-exclusive licenses in the 2265
field of wireless telegraphy to make and use (but not to sell, lease or otherwise dispose of, except to Companies of the Bell System) apparatus and systems for television for use solely in combination with apparatus and systems for two-way telephony for the purpose of giving a public service combining television and speech, but said licenses do not include the making or using of such apparatus for transmission or reception of programs.

(*e*) The General Company grants to the Telephone Company non-exclusive licenses in the

field of wireless telegraphy for combined wireless telephone and telegraph sets, other than sets for transoceanic communication, (1) for use in communication by, with and between airplanes, airships and other automotive devices other than ships and railway vehicles, and (2) for export from the continental United States for use for any purpose other than transoceanic communication.

2267 (*f*) The Telephone Company grants to the General Company: (1) exclusive licenses, including the right to grant licenses to others, in the field of wireless telegraphy for purposes of public service communication, subject, however, to non-exclusive rights which the Telephone Company reserves for itself and its present and future subsidiaries under its and their patents to make, use and sell in said field and to grant to the United States Government licenses to make and to have made for it and to use apparatus for such purposes; and (2) non-exclusive licenses,
2268 including the right to grant non-exclusive licenses to others, for all other purposes in the field of wireless telegraphy other than the purposes covered by paragraph (*a*) of this section 2 and by section 8 of this Article VI.

(*g*) The General Company grants to the Telephone Company non-exclusive licenses for printing telegraph apparatus for use in the fields of wire and wireless telegraphy.

(*h*) The Telephone Company agrees that printing telegraph apparatus manufactured by Teletype Corporation (which is a subsidiary of West-

ern Electric Company, Incorporated) shall be sold by Teletype Corporation to the General Company, upon the basis defined in Article X hereof, for use only within the fields for which licenses are herein granted to the General Company. The Telephone Company agrees that Teletype Corporation will grant to the General Company, under patents and inventions owned or controlled by the Teletype Corporation (so far as and to the extent that Teletype Corporation has the right, in view of its existing obligations, 2270 to grant such licenses) licenses of the same character and scope as the licenses herein granted by the Telephone Company to the General Company, except that no licenses are agreed to be granted with respect to printing telegraph apparatus under any patents or inventions of the Teletype Corporation; and the General Company agrees that all non-exclusive rights and licenses granted to or reserved by the Telephone Company hereunder may be extended by the Telephone Company to the Teletype Corporation.

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(i) The licenses granted to the General Company in this section 2 do not cover the use of wireless telegraph stations for giving a telephone service, except as licensed in section 4 of this Article VI.

3. Wire Telegraphy.

(a) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of wire telegraphy for the transmission and reception of programs over

electric light, electric heat, electric power and electric traction lines, subject, however, to the provisions of paragraph (*b*) of section 5 of this Article VI regarding electrical interference.

(*b*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telegraphy to make (but not to sell, lease or otherwise dispose of) apparatus and systems, and (1) to use such apparatus and systems for its own communication and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement, and (2) to use (but not to furnish to others) such apparatus and systems upon wire telegraph systems owned by it, or leased to it for its operation (other than transoceanic cables), for all purposes other than giving a service by wire telegraphy analogous to the services given by the Companies of the Bell System by wire telegraphy at the date of this agreement, commonly designated as leased wire service, special contract service or teletypewriter exchange service, and other than train dispatching; but no licenses are granted with reference to transoceanic wire telegraphy.

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(*c*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telegraphy for apparatus and systems for communication only in connection with the operation of apparatus for power purposes, but not for transmission of messages for the public.

(*d*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telegraphy for apparatus and sys-

tems for communication between parts of a train (without regard to the nature of the motive power thereof), or between trains following or approaching each other upon the same system of tracks, or between trains approaching a cross-over or junction point of the systems of tracks upon which they are running, or between trains and signal towers or way-stations within short distances thereof, but in each instance only for use in connection with the operation of such trains but not for train dispatching. 2276

(e) The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for all purposes in the field of wire telegraphy (other than that covered by paragraph [a] of this section 3) on land, and over ocean cables not more than one hundred miles in length, and between the main body of the United States and Cuba; but no licenses are granted with reference to other transoceanic wire telegraphy. 2277

4. Wireless Telephony.

A. In general.

(a) The Telephone Company grants to the General Company non-exclusive licenses in the field of wireless telephony to make and use (but not to sell, lease or otherwise dispose of) apparatus and systems for its own communication and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement, but not for transmission of messages

(as distinguished from programs) for the public except temporarily in emergencies due to storms or other catastrophes.

(*b*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of amateur wireless telephony; and the General Company grants to the Telephone Company non-exclusive licenses to
2279 make and sell apparatus in the field of amateur wireless telephony limited as hereinafter in this paragraph (*b*) provided. The licenses by this paragraph (*b*) granted by the Telephone Company to the General Company shall be free of royalties, but all apparatus sold by the Telephone Company under the licenses granted by this paragraph (*b*) shall be treated as if such apparatus were apparatus for one-way wireless telephone reception of programs under the provisions of paragraph (*d*) of subdivision C of this section 4 and shall be governed by all the provi-
2280 sions of said paragraph (*d*).

(*c*) Each party grants to the other non-exclusive licenses for headphones for all purposes in all fields covered by this agreement; provided, however, that headphones sold by the Telephone Company as part of complete apparatus for one-way wireless telephone reception of programs shall be included in the determination of the royalties payable by the Telephone Company under the provisions of paragraph (*d*) of subdivision C of this section 4.

(*d*) Each party grants to the other non-exclusive licenses in the field of wireless telephony for apparatus and systems for communication

only in connection with the operation of apparatus for power purposes, but not for transmission of messages for the public.

(c) Each party grants to the other non-exclusive licenses in the field of wireless telephony for apparatus and systems for communication between parts of a train (without regard to the nature of the motive power thereof), or between trains following or approaching each other upon the same system of tracks, or between trains approaching a cross-over or junction point of the systems of tracks upon which they are running, or between trains and signal towers or way-stations within short distances thereof, but in each instance only for use in connection with the operation of such trains but not for train dispatching. 2282

B. TWO-WAY WIRELESS TELEPHONY.

(a) The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of two-way transoceanic wireless telephony to make and use (but not to sell, lease or otherwise dispose of) apparatus and systems for use in the continental United States; but such licenses do not include use for transmission or reception of messages offered for telephonic transmission. 2283

(b) The General Company grants to the Telephone Company non-exclusive licenses in the field of two-way transoceanic wireless telephony, to make and sell to stations outside the conti-

nental United States engaged in co-operation with the Telephone Company in giving for the public a transoceanic telephone service, apparatus for use in giving such service; and the Telephone Company grants to the General Company non-exclusive licenses including the right to grant non-exclusive licenses to others in the field of two-way transoceanic wireless telephony for apparatus for export from the continental United States.

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(*c*) The Telephone Company grants to the General Company non-exclusive licenses in the field of two-way wireless telephony for combined wireless telephone and telegraph sets, other than sets for transoceanic communication, (1) for use in communication by, with and between airplanes, airships and other automotive devices other than ships and railway vehicles, and (2) for export from the continental United States for use for any purpose other than transoceanic communication.

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(*d*) The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of two-way wireless telephony (other than in the field of transoceanic wireless telephony) for all purposes other than the purposes covered by subdivision A of this section 4.

(*e*) The licenses granted to the Telephone Company in this subdivision B do not include the use of wireless telephone stations for giving a telegraph service, except as licensed in section 2 of this Article VI.

C. One-Way Wireless Telephony.

(*a*) Each party grants to the other non-exclusive licenses in the field of one-way wireless telephony for apparatus and systems for the purpose of giving a business, commercial or official service limited to a particular customer or class of customers; but the licenses granted by this paragraph (*a*) do not include the making or using of such apparatus for (1) transmission or reception of messages for the public 2288
generally or (2) transmission or reception of programs; and the licenses granted to the Telephone Company with respect to transmission for the purposes covered by this paragraph (*a*) include only apparatus for the transmission of such service from and within the continental United States.

(*b*) Each party grants to the other non-exclusive licenses in the field of one-way wireless telephony for apparatus and systems for use for transmitting for purposes other than covered 2289
by paragraph (*a*) of this subdivision C, including, however, apparatus for wireless telephone reception furnished as a part of the equipment of transmitting stations; but the licenses granted by this paragraph (*b*) do not include apparatus in the field of amateur wireless telephony.

(*c*) The General Company grants to the Telephone Company non-exclusive licenses to make and use (but not to sell, lease or otherwise dispose of, except to Companies of the Bell System) apparatus for one-way wireless telephone reception (including apparatus for the reception

of programs) for its own communication or that of Companies of the Bell System, and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement.

(*d*) The General Company grants to the Telephone Company non-exclusive licenses for apparatus for one-way wireless telephone reception of programs; provided, however, that the licenses granted in this paragraph (*d*) shall be
2291 subject to the following terms and limitations:

(1) Tubes (thermionic devices) sold as separate devices for use in apparatus covered by this paragraph (*d*), or in apparatus which under other provisions of this agreement shall be treated as apparatus covered by this paragraph (*d*), shall be to the amount of $1,000,000 free of royalties during each calendar year, and said tubes in excess of said amount in any year shall be subject to a royalty of five per cent. computed as hereinafter provided; but no li-
2292 censes are granted in this paragraph (*d*) for tubes in excess of $2,000,000 in amount or 1,000,000 in number during any calendar year; and provided further that where said tubes are sold as parts of receiving sets or other complete units designed for operation with such sets, such tubes shall be treated as parts of the receiving set or other unit and shall not be classified under this sub-paragraph (1).

(2) Receiving sets and apparatus which under other provisions of this agreement shall be treated as apparatus covered by this paragraph (*d*), or parts thereof (including loud speakers,

mplifiers and tubes other than thermionic de-
ices), shall be to the aggregate amount of
1,500,000 free of royalty in each calendar year,
nd such sets, apparatus or parts in excess of
aid amount shall be subject to a royalty of
ve per cent. computed as hereinafter provided;
ut no licenses are granted in this paragraph
d) for receiving sets, apparatus and parts in
xcess of $3,000,000 in amount in any calendar
ear, provided, that if the sale of tubes sold as
eparate devices amount to less than $2,000,000 2294
uring any year, the amount of such deficiency
hall be added to the amount of receiving sets,
pparatus and parts which may be sold under
he license granted in this paragraph (*d*).

(3) For any portion of the first or last calen-
ar year of this agreement, less than an entire
alendar year, during which royalties shall be
ayable hereunder, the amounts which may be
old free of royalty and subject to royalty re-
pectively shall be those proportions of the
mounts which may be sold free of royalty and 2295
ubject to royalty respectively in the entire
alendar year which said fractional part of a
alendar year bears to a calendar year.

(4) The aforementioned amounts sold free of
oyalty, and the amounts subject to royalty, shall
e based on the price at which the apparatus is
old by the manufacturer thereof, before cash
iscount, freight and advertising allowances or
ther similar deductions.

(5) Sales for export shall be included in de-
rmining the amounts sold free of royalty, and

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the amounts subject to royalty, on the basis of the price at which the sale is made.

(6) In ascertaining the amount of the sales which are free from royalty and the amount of the sales upon which royalties are to be paid hereunder, where apparatus is sold any part of which embodies any invention of any of the patents in force at the time of such sale under which licenses are granted in this paragraph
2297 (*d*), the selling price of the apparatus sold shall be taken as the basis; but apparatus not covered by any of said patents when sold not assembled for operation with apparatus covered by such patents, shall not be taken into account in computing the amount of sales which are free from royalty or the amount of sales which are subject to royalty, unless such apparatus not covered by such patents is adapted for operation with apparatus covered by such patents and is sold in such manner that its sale or its use in connection with apparatus covered by such patents
2298 would, except for the licenses granted by this paragraph (*d*), constitute contributory infringement of the patents under which such licenses are granted. Where radio receiving sets are sold for use in combination with public address apparatus or other apparatus not subject to royalties under this agreement, the sale price of the public address or other apparatus shall not be included in the amount of the sales which are free from royalty or the amount of the sales which are subject to royalty. Chemical primary batteries, wet or dry, and chemical storage batteries, not sold as part of apparatus upon which royalties are payable hereunder, or wiring in a

building in connection with a sale of such apparatus, shall not be taken into account in computing the amount of sales which are free from royalty or the amount of sales which are subject to royalty.

(*e*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for apparatus and systems for one-way wireless telephone reception of programs.

2300

(*f*) Subdivision A of this section 4 and paragraphs (*a*) to (*e*), inclusive, of this subdivision C are intended to make provision for all anticipated fields of use of apparatus for one-way wireless telephone reception. If it should develop that there are other fields of use of such apparatus not covered herein licenses shall be granted in such other fields of use to the respective parties in accordance with the principle underlying said other paragraphs of this subdivision C, with special reference to the interest of the General Company in the field on one-

2301

way wireless telephone reception of programs, on the one hand, and of the Telephone Company in the field of one-way wireless telephone reception for giving a service of a business, commercial or official nature, on the other hand. If the parties cannot agree with respect to such licenses, their respective rights shall be determined by arbitration in accordance with the provisions of Article XIII.

5. Wire Telephony.

(*a*) The Telephone Company grants to the General Company non-exclusive licenses, includ-

ing the right to grant non-exclusive licenses to others, and the General Company grants to the Telephone Company non-exclusive licenses, in the field of wire telephony for apparatus for carrier current telephone communication, both one-way and two-way, over electric light, electric heat, electric power and electric traction lines, or partly over such lines and partly across wireless gaps, but in each instance only for the use of the owner or operator of such
2303 lines in the business of such owner or operator, and not for transmission of messages for the public except temporarily in emergencies due to storms or other catastrophes.

(*b*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of one-way wire telephony for apparatus for the transmission and reception of programs over electric light, electric heat, electric power and electric traction lines including
2304 the use of such lines for pick-up lines or for connecting two or more separate electric systems in connection with the transmission or reception of programs over such lines or by means of wireless telephony, but not including the use of other wires for such purposes except as licensed in paragraph (*c*) of this section 5; provided, however, that no apparatus is licensed under this paragraph (*b*), or under paragraph (*a*) of section 3 of this Article VI, the use of which would electrically interfere unreasonably with the Telephone Company's systems of wire communication for which it is licensed under this agreement, as the same may now exist or may

hereafter normally be developed, or with any system of the Telephone Company for transmitting programs by wire telephony over lines other than electric light, electric heat, electric power and electric traction lines, where such system exists prior to the installation in the same locality by the General Company of apparatus licensed under this paragraph (*b*), and the Telephone Company shall be the sole judge of the existence of such unreasonable interference. The Telephone Company agrees whenever 2306
requested by the General Company, but at the expense of the General Company consented to by it before being incurred, to co-operate with the General Company in every reasonable way to enable the General Company to develop apparatus within the licenses granted by this paragraph (*b*) which will avoid such electrical interference.

(*c*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony, both one-way and two- 2307
way, to make (but not to sell, lease, or otherwise dispose of) apparatus and systems, and to use such apparatus and systems solely upon systems owned by it, for its own communication and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement, but not for transmission of messages (as distinguished from programs) for the public except temporarily in emergencies due to storms or other catastrophes. The Telephone Company agrees to furnish to the General Company, when requested, pick-up or connecting wires, if available, for its use in the transmission of programs

to or from its stations for such transmission either by means of wireless telephony or over electric light, electric heat, electric power and electric traction lines, or for its use in electrical sound recording, on terms at least as favorable as the terms given to others than the General Company, and agrees that in furnishing such pick-up and connecting wires for such service there shall be no discrimination against the General Company.

2309 (*d*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony for apparatus for the distribution, to an assembled audience, or to rooms within a building or a group of substantially adjacent buildings commonly owned or operated, or to rooms within a ship, airship or train, of matter from apparatus for one-way wireless telephone reception, or from apparatus for reception in the field covered by paragraph (*b*) of this section 5, or from phonographs, in each case
2310 located in the immediate vicinity of such audience or within the building or group of buildings, ship, airship, or train within which such distribution is made.

(*e*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony, both one-way and two-way, for apparatus and systems for communication only over wires used in connection with apparatus for remote control or actuation of apparatus for power purposes and only in connection with the operation of apparatus for power purposes, but not for transmission of messages for the public.

(*f*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony, both one-way and two-way, for apparatus for communication between parts of a train (without regard to the nature of the motive power thereof), or between trains following or approaching each other upon the same system of tracks, or between trains approaching a cross-over or junction point of the systems of tracks upon which they are running, or between trains and signal towers or way-stations 2312
within short distances thereof, but in each instance only for use in connection with the operation of such trains but not for train dispatching.

(*g*) The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of wire telephony, both one-way and two-way, for all purposes other than for the purposes covered by the paragraphs (*a*) and (*b*) of this section 5; provided, however, that the licenses granted by this paragraph (*g*) for 2313
apparatus for reception of programs in connection with a service of transmitting programs by wire telephony (analogous to wireless broadcasting) over lines other than electric light, electric heat, electric power and electric traction lines, are licenses only to make and use, to lease to subscribers to such a service, and to sell only at retail (except as to sales for export) either directly or through the Telephone Company's own direct agents, and said licenses are subject to the condition that the Telephone Company shall retain in itself, or in one or more of its sub-

sidiaries, title to the apparatus and control of its disposition until it is so sold.

6. Power Purposes and Household Devices.

The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the fields of (*a*) distance actuation and control by wireless, (*b*) power purposes (including apparatus for distance actuation and
2315 control of apparatus for power purposes and apparatus for indicating at remote points the condition or position, of apparatus for power purposes) and (*c*) household devices, in each case for purposes other than communication purposes.

7. Railroad Signalling, Radio Goniometry, X-ray Apparatus.

(*a*) The General Company grants to the Telephone Company non-exclusive licenses in the field of radio goniometry for apparatus for use
2316 as part of apparatus in respect of which the Telephone Company is otherwise licensed under this agreement.

(*b*) The General Company grants to the Telephone Company non-exclusive licenses in the field of railway signalling for apparatus incidental to apparatus for train dispatching, for use only by the train dispatcher or similar official for operating at will, and not automatically, signals, switches, brakes and stops.

(*c*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to

others, in the fields of railroad signalling, X-ray apparatus and apparatus associated therewith, and radio goniometry.

8. Train Dispatching.

The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, in the field of train dispatching.

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9. Electric Sound Recording.

(*a*) The General Company grants to the Telephone Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for electrical apparatus for the production of sound records (which records are for the private use of the maker, and not for commercial use or sale) in combination or connection with apparatus in the field of wire telephony other than in connection with apparatus in the field covered by paragraph (*b*) of section 5 of this Article VI. 2319

(*b*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for electrical apparatus for the production of sound records (which records are for the private use of the maker, and not for commercial use or sale) in combination or connection with apparatus for one-way wireless telephone reception of programs and with apparatus in the field covered by paragraph (*b*) of section 5 of this Article VI.

(*c*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for electrical apparatus for the production in homes (which records are for the private use of the maker, and not for commercial use or sale) of sound records of entertainment and educational matter, other than apparatus covered by paragraphs (*a*) and (*b*) of this section 9.

2321 (*d*) The General Company grants to the Telephone Company non-exclusive licenses for electrical apparatus for the production of sound records in homes, for entertainment or educational purposes (which records are for the private use of the maker and not for commercial use or sale), provided that all apparatus sold under the licenses granted in this paragraph (other than that covered by paragraphs [*a*] and [*c*] hereof) shall be treated as if such apparatus were apparatus for one-way wireless telephone reception of programs under the provisions of para-
2322 graph (*d*) of sub-division C of Section 4 of Article VI and all of the provisions of said paragraph (*d*) shall apply thereto.

(*e*) Each party grants to the other non-exclusive licenses for electrical apparatus for the production of sound records other than apparatus covered by paragraphs (*a*), (*b*), (*c*) and (*d*) of this section 9.

10. Electric Phonographs.

(*a*) The General Company grants to the Telephone Company non-exclusive licenses, including

the right to grant non-exclusive licenses to others, for electric phonographs for use in combination or connection with apparatus in the field of wire telephony other than in combination or connection with apparatus in the field covered by paragraph (*b*) of section 5 of this Article VI; provided, however, that the licenses granted by this paragraph (*a*) for phonographs for private use in homes for entertainment and educational purposes are licenses only to make and use in connection with a service of transmitting 2324
programs by wire telephony over lines other than electric light, electric heat, electric power and electric traction lines, to lease to subscribers to such a service, and to sell only at retail (except as to sales for export) either directly or through the Telephone Company's own direct agents, and said licenses are subject to the condition that the Telephone Company shall retain in itself, or in one or more of its subsidiaries, title to the apparatus and control of its disposition until it is so sold.

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(*b*) The General Company grants to the Telephone Company a non-exclusive license for electric phonographs (including electric phonographs in combination or connection with apparatus for wireless telephone reception) for private use in homes for entertainment and educational purposes, other than for the purposes covered by paragraph (*a*) of section 10 of this Article VI, but all apparatus sold by the Telephone Company under the licenses granted by this paragraph (*b*) shall be treated as if such apparatus were apparatus for one-way wireless telephone reception of programs under the provisions of

paragraph (*d*) of sub-division C of section 4 of Article VI and shall be governed by all of the said provisions of said paragraph (*d*).

(*c*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for electric phonographs in combination or connection with apparatus for one-way wireless telephone reception, and in combination or
2327 connection with apparatus in the field covered by paragraph (*b*) of section 5 of this Article VI.

(*d*) The Telephone Company grants to the General Company non-exclusive licenses, including the right to grant non-exclusive licenses to others, for electric phonographs for private use in homes for all entertainment and educational purposes other than those covered by paragraphs (*a*) and (*c*) of this section 10.

(*e*) Each party grants to the other non-exclu-
2328 sive licenses for electric phonographs for all purposes other than those covered by paragraphs (*a*), (*b*), (*c*) and (*d*) of this section 10.

11. Apparatus for Co-ordination of Sound and Pictures.

(*a*) The rights and licenses of the parties hereto in respect of apparatus for transmitting, receiving, recording or reproducing sound in co-ordination, synchronism, or timed relation with the taking, transmission or projection of pictures shall, in so far as the fields of wire and wireless telegraphy and telephony, electrical sound

recording and electric phonographs are involved, be governed by the other provisions of this agreement relating to said fields.

(*b*) In so far as apparatus for the taking or projection of pictures and apparatus for co-ordinating, synchronizing or timing such taking or projection in relation to the recording or reproduction of sound are not covered by the provisions of paragraph (*a*) of this section 11, the Telephone Company grants to the General Company non-exclusive licenses, including the right 2330
to grant non-exclusive licenses to others, for such apparatus for private use in homes for entertainment and educational purposes, and each party grants to the other non-exclusive licenses for such apparatus for all other purposes.

(*c*) The General Company grants to the Telephone Company a non-exclusive license for apparatus for private use in homes for entertainment and educational purposes for the projection of pictures and the reprodnction of sound from sound records in co-ordination, synchro- 2331
nism or timed relation therewith, but all apparatus sold by the Telephone Company under the licenses granted by this paragraph (*c*) shall be treated as if such apparatus were apparatus for one-way wireless telephone reception of programs under the provisions of paragraph (*d*) of sub-division C of section 4 of this Article VI and shall be governed by all of said provisions of said paragraph (*d*).

2. Public Address Systems.

The Telephone Company grants to the General Company non-exclusive licenses for public

address systems, including the combination or connection thereof with other apparatus for which the General Company is otherwise licensed hereunder, provided, however, that the licenses granted in this section 12 (1) do not include apparatus for giving by wire telephony a service analogous to wireless broadcasting (but do include apparatus for use in localities specified in paragraph [*d*] of section 5 of this Article VI), and (2) shall be subject to the following terms
2333 and limitations:

(1) Public address system apparatus and parts thereof shall be to the aggregate amount of $1,500,000 free of royalty in each calendar year and such apparatus and parts thereof in excess of said amount shall be subject to a royalty of 5% computed as hereinafter provided; but no license is granted for public address system apparatus and parts thereof in excess of $5,000,000 in amount during any calendar year.

2334 (2) For any portion of the first or last calendar year of this agreement, less than an entire calendar year, during which royalties shall be payable hereunder, the amounts which may be sold free of royalty and subject to royalty respectively shall be those proportions of the amounts which may be sold free of royalty and subject to royalty respectively in the entire calendar year which said fractional part of a calendar year bears to a calendar year.

(3) The aforementioned amounts sold free of royalty, and the amounts subject to royalty, shall be based on the price at which such apparatus

is sold by the manufacturer thereof, before cash discount, freight and advertising allowances or other similar deductions.

(4) Sales for export shall be included in determing the amounts sold free of royalty, and the amounts subject to royalty, on the basis of the price at which the sale is made.

(5) In ascertaining the amount of the sales which are free from royalty and the amount of 2336
the sales upon which royalties are to be paid hereunder, where apparatus is sold any part of which embodies any invention of any of the patents in force at the time of such sale under which licenses are granted in this section 12, the selling price of the apparatus sold shall be taken as the basis; but the apparatus not covered by any of said patents, when sold not assembled for operation with apparatus covered by such patents, shall not be taken into account in computing the amount of sales which are free from royalty or the amount of sales which are 2337
subject to royalty, unless such apparatus not covered by such patents is adapted for operation with apparatus covered by such patents and is sold in such manner that its sale or its use in connection with apparatus covered by such patents would, except for the licenses granted by this agreement, constitute contributory infringement of the patents under which such licenses are granted. Where public address system apparatus is sold for use in combination with apparatus for one-way wireless telephone reception of programs, the sale price of such receiving apparatus shall not be included in the

amount of the sales which are free from royalty or the amount of the sales which are subject to royalty. Chemical primary batteries, wet or dry, and chemical storage batteries not sold as part of apparatus upon which royalties are payable hereunder, or wiring in a building in connection with a sale of apparatus shall not be taken into account in computing the amount of sales which are free from royalty or the amount of sales which are subject to royalty.

2339

13. Submarine Signaling, Scientific and Therapeutic Apparatus, Tools and Other Applications.

Each party grants to the other, non-exclusive licenses in the following fields:

Submarine signaling.

Scientific apparatus for use of laboratories, colleges and scientific societies, as distinguished from commercial use.

2340

Mechanical phonographs.

Wireless apparatus for use of professional investigators (as distinguished from amateurs) for experimental purpose only.

Therapeutic apparatus other than X-ray devices and appliances.

Tools, machinery, appliances, materials, methods and processes for the manufacture, installation and repair of apparatus for use in fields for which the grantee is licensed hereunder.

All applications, not herein otherwise specified, of inventions pertaining or applicable to or to the use of vacuum tubes,

and to generating (directly or from other currents), modifying, amplifying, transmitting or receiving electro-magnetic waves, variations or impulses for other than power purposes.

ARTICLE VII.

Provisions With Reference to Foregoing Licenses.

2342

1. Whenever licenses granted under the terms of this agreement are based upon rights held by the licensor under any agreement requiring the payment of royalties or other deferred payments, measured by the use made of the invention, the party accepting such licenses shall make payments measured by its use of the invention at the same rate and upon the same terms as those agreed to be made by the party originally acquiring the rights.

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2. Upon the termination of this agreement under the provisions of Article XIV hereof all licenses herein granted shall, during the terms of the several patents, issued or to be issued, in respect of which such licenses exist at the date of termination, continue unaffected and of the same scope and character herein expressed, so far as the grantor thereof has the right to grant such licenses for such terms; and such licenses shall not be limited by the term of this agreement.

3. (*a*) The Telephone Company may grant sub-licenses to the operating Companies of the

Bell System (but not manufacturing companies) which now or may from time to time be giving a communications service.

(*b*) Each party hereto may grant to its subsidiaries sub-licenses under the licenses granted to it herein; provided, however, that each subsidiary to which a sub-license shall be granted (excepting, however, sub-licensees pursuant to paragraph (*a*) of this section 3 and except also
2345 the Teletype Corporation as to which special provision is made elsewhere in this agreement) shall either have entered into an agreement with its parent company effectively subjecting to this agreement all United States patents then or thereafter during the term of this agreement owned or controlled by it, or have executed to the party hereto other than its parent company an instrument granting to such other party licenses under said patents co-extensive with the licenses herein granted to such other party. Use by any subsidiary of any sub-license granted
2346 under this agreement shall for all purposes of this agreement, including determination of royalties payable hereunder, be deemed to be use by its parent company, and ownership, lease or operation of any telephone or telegraph system or station by any subsidiary shall be deemed to be ownership, lease or operation of such system or station by its parent company for all purposes of this agreement. Wherever in this agreement either party is granted a general right to grant non-exclusive licenses to others such rights shall nevertheless be subject to the provision of this paragraph (*b*) so far as concerns the grant of sub-licenses to subsidiaries.

(*c*) In addition to the sub-licensing provided for in the foregoing paragraphs (*a*) and (*b*), each party hereto may assign or grant sub-licenses under any of the rights granted to it hereunder, which are not expressed as including the right to grant sub-licenses to others, provided that in each instance the assent of the other party is first obtained.

(*d*) When either party shall enter into an agreement with any of its subsidiaries effectively subjecting to this agreement all United States 2348
patents then or thereafter during the term of this agreement owned or controlled by such subsidiary, such party shall promptly give the other party appropriate notice of such agreement.

(*e*) Each party shall enter into an agreement with each of its subsidiaries which is engaged primarily or wholly in the conduct of research and development work in the fields for which licenses are granted to the other party under this agreement whereby the United States patents owned or controlled by such subsidiary dur- 2349
ing the term of this agreement shall become effectively subject to this agreement.

(*f*) Each party may, subject to the provisions of section 4 of this Article VII, sell or lease to any sub-licensee having a sub-license to use granted under the provisions of any of paragraphs (*a*), (*b*) and (*c*) of this section 3, apparatus for the use of such sub-licensee under such sub-license, notwithstanding that the party granting such sub-license may not be licensed under this agreement generally to sell, lease or otherwise dispose of such apparatus.

2350 *Plaintiffs' Exhibit No. 40.*

(g) All sub-licenses granted hereunder shall be subject to all limitations and obligations attaching to the apparatus or system in respect of which sub-licenses are granted, whether under the patents, or under the instruments by which any party acquired the patents or licenses under them, or under this agreement.

(h) No disposition by either party of rights hereunder acquired by it, shall relieve such
2351 party of any of its obligations under this agreement, or restrict the rights of the parties hereto in operating under or modifying this agreement.

4. Each party agrees that, so far as practicable, it will, in disposing of apparatus embodying inventions pertaining or applicable to vacuum tubes, or to generating, modifying, amplifying, transmitting or receiving electro-magnetic waves, or other apparatus or material the unrestricted sale of which would deprive the other
2352 party of rights to which it is entitled hereunder, use such precautions by contracts, leases, restricted licenses or otherwise as may be necessary or advisable in order to prevent its subsidiaries, sub-licensees, customers or others from acquiring (by acquisition of apparatus from it or otherwise) licenses to use the same which the party disposing thereof has no right to grant.

5. All royalties payable under any provision of this agreement shall continue to be payable to the ends of the terms of the patents in respect of which such royalties are payable, notwithstanding any termination of this agreement.

6. The admission of validity implied in the acceptance of licenses hereunder is limited to the field for which such licenses are granted or agreed to be granted.

7. No licenses under foreign patents are now granted or are to be implied; but except as herein otherwise expressly provided the licenses to make, sell, lease or otherwise dispose of, herein granted under United States patents include the right to make, sell, lease or otherwise dispose of for use abroad in the fields for which 2354
such licenses under United States patents are granted, but not for use abroad in other fields. Each party agrees not to export to any country in which the other party has an affiliated company, apparatus purchased from such other party which such other party could not itself so export, in view of existing contract obligations, after notice of such obligations and without first securing a written waiver thereof.

8. Each party represents that in its best judgment it has no outstanding obligations which 2355
would prevent it from entering into the agreements and from granting the licenses herein expressed. If, however, it is found that there are such conflicting obligations, the present agreement is made subject to the right to fulfil those obligations.

ARTICLE VIII.

Interferences.

The parties agree to use reasonable endeavors to settle, without litigation, interferences now pending or which may arise involving inventions within the scope of this agreement.

ARTICLE IX.

Co-operation and Exchange of Information.

1. Each party agrees that it will, from time to time during the term of this agreement, freely permit the other to have all information in its possession which it may have a right to dispose of with reference to its standardized apparatus or methods or processes applicable to the uses
2357 of the other party in fields in which such other party is granted licenses hereunder, but any secret process so disclosed shall be maintained in secrecy by the party to whom it is disclosed. Blue prints, etc., shall be furnished at the cost of preparing the same. For the purpose of acquiring such information each party shall at all reasonable times have access (through a reasonably limited number of accredited representatives who are regular employees under obligation to assign inventions to their employers), to the laboratories, factories and wireless stations
2358 of the other, to the end that development work may be expedited and rendered the more effective.

Each party shall, with reference to inventions owned or controlled by it, under which the other party is entitled to rights hereunder and which either party deems to be of sufficient value to and aid the other to obtain proper patents thereon.

2. Each party shall afford the engineering representatives of the other the fullest possible facilities, consistent with the reasonable operation of the other, for experimenting and for develop-

ing and testing apparatus and systems for use in transoceanic telephony, and each shall at all times be given such an opportunity to make such tests, experiments and observations in the transoceanic stations of the other as do not conflict with the service then being rendered by such stations, and each party shall afford to the other such facilities for test, experimentation and observations on ships as it may be able to extend.

3. In the operation of wireless and carrier-current communication, the parties shall co-operate to the end that interference with the operations of either party, due to the operations of the other, shall be minimized, it being recognized that the available wave lengths are limited. 2360

ARTICLE X.

Purchases as Between Parties.

It is recognized that each party has and will normally continue to have facilities for manufacturing certain apparatus or parts thereof which may be required by the other party under its licenses hereunder, and that a duplication of such facilities may be wasteful and uneconomical. Each party agrees that it will upon request manufacture for and sell and deliver to the other, with reasonable business promptness and within its reasonable manufacturing capacity, on receipt of orders from time to time, and at favorable prices not to exceed those charged to others (except subsidiaries and, in the case of the Telephone Company, Companies of the Bell System) purchasing in like quantities for use in the 2361

United States, such apparatus and parts as the former is engaged in manufacturing from time to time and as the latter may desire for use in the fields for which licenses are granted to it by this agreement.

ARTICLE XI.

Litigation.

1. Neither party shall bring suit for infringe-
2363 ment of patents against the other party, or against the distributors and jobbing houses owned by or affiliated with either party, because of sales by such party, or by its (or its subsidiaries') distributors or jobbing houses, of apparatus made in the United States, by others than the parties hereto, it being agreed that the remedy in case of any such infringement shall be only by suit against the manufacturer of those devices; but nothing herein contained shall be construed as the granting of a right to sell infringing apparatus manufactured by others.

2364 2. In all cases of infringement of a patent of either party in a field in which the licenses herein granted to the other party include the general right to grant sub-licenses, if the party holding title to such patent shall not bring suit against the infringer within thirty days after receipt from the other party of written notice and full information of such infringement together with a written offer from such other party to pay half the cost and expenses of such suit, then (*a*) the party having given such notice, information and offer may at its own expense bring suit against the infringer in question in the name of the party holding legal title to the patent, and

(*b*) such party holding title to the patent shall assign to the other party all claims, demands and rights of action against the particular infringer designated in such notice on account of any and all past and future infringements of such patent in said field.

3. If, however, the party holding title to such patent shall bring suit against the infringer within thirty days after receipt of said notice and information from the other party, then any 2366
recoveries from the infringer shall be applied first toward the reimbursement of the costs and expenses of such suit, and the remainder, if any, shall be divided between the parties as their interests appear. In any such case the party holding title to the patent in suit shall not release or license the infringer or otherwise settle or dismiss the suit without the consent of the party having the general right to grant sub-licenses.

ARTICLE XII.

2367

Releases.

Each party reserves to itself the right to deal with the United States Government with reference to settlement for past use of its inventions in telephone and telegraph apparatus and systems. Subject to the foregoing, each party releases the other and the vendees and users of apparatus or systems made by it, from all claims growing out of past infringement of patents, by reason of the manufacture, use and sale of such apparatus and systems by the other party, and its resale or use by such vendees and users.

2368 *Plaintiffs' Exhibit No. 40.*

ARTICLE XIII.

Arbitration.

In case any controversy under this agreement (except in respect of interference or priority of rights to inventions or patents) shall arise between the parties to this agreement, which they are unable to adjust between themselves, it shall be settled by arbitration pursuant to the Arbi-
2369 tration Law of the State of New York in the following manner:

Either party may by notice in writing served on the other, appoint one arbitrator and call upon the other to appoint a second arbitrator within thirty days after the receipt of such notice; and each party agrees that upon receiving any such notice it will so appoint an arbitrator. The two arbitrators thus appointed shall, within thirty days after the appointment of the one last appointed, jointly appoint a third arbitrator. The controversy shall be submitted to the three
2370 arbitrators in such manner as they shall direct and their decision, or the decision of a majority of them, rendered in writing, shall be final, conclusive and binding upon the parties. In the event that a second arbitrator shall not be appointed as above provided or the two arbitrators first appointed shall fail to appoint a third, application may be made by either party to the Supreme Court of the State of New York, or to a judge thereof, to designate and appoint an arbitrator or arbitrators, as the case may require, as provided by said Arbitration Law. Each party shall pay its own expenses in connection with the arbitration but the conpensation

and expenses of the arbitrators shall be borne in such manner as may be specified in their decision in writing.

ARTICLE XIV.

Termination of Agreement.

This agreement shall continue until December 31, 1954, but shall automatically continue thereafter until cancelled on three years' written notice given after December 31, 1951, by one party to the other party. 2372

ARTICLE XV.

Further Assurances.

The parties agree to execute and deliver such further instruments as may reasonably be necessary for carrying out the provisions and purposes of this agreement.

ARTICLE XVI. 2373

Successors.

This agreement is binding upon and shall inure to the benefit of each of the parties hereto and their several successors in business, except that either party may transfer or dispose of any part or parts of its business not involving the grant of any licenses under this agreement, and in such case this agreement shall not be binding upon or inure to the benefit of the successor to that part of the business so transferred.

2374 *Plaintiffs' Exhibit No. 40.*

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed on the day and year first above written, by their proper officers thereunto duly authorized.

GENERAL ELECTRIC COMPANY,
(Sgd.) By CHARLES W. APPLETON,
Vice-President.
O. K. A. G. D.
[SEAL]

2375 Attest:

(Sgd.) J. W. LEWIS
Asst. Secretary.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
By (Sgd.) WALTER S. GIFFORD,
President.
G. E. F.
C. M. B.

2376 Attest:

(Sgd.) A. A. MARSTERS,
Secretary.

[SEAL]

2377

Plaintiffs' Exhibit No. 41.

DISTRICT COURT OF THE UNITED STATES,

District of Delaware.

United States of America,
Petitioner,
against
Radio Corporation of America, General Electric Company, International General Electric Company, Westinghouse Electric & Manufacturing Company, Westinghouse Electric International Company, National Broadcasting Company, Inc., R. C. A. Communications, Inc., R. C. A. Photophone, Inc., R. C. A. Radiotron Company, Inc., R. C. A. Victor Company, Inc., American Telephone and Telegraph Company, Western Electric Company, Inc., General Motors Corporation and General Motors Radio Corporation,
Defendants.

2378

In Equity No. 793.

2379

Stipulation

Referred to in Consent Decree of November 21, 1932

1. The petitioner asserts that the matters and facts alleged in its Amended and Supplemental

2380 *Plaintiffs' Exhibit No. 41.*

Petition are true and that by means thereof the defendants have violated the Anti-Trust Laws of the United States as charged in said Petition. The defendants maintain the truth of their answers in this cause and assert that they have not violated the Anti-Trust Laws in fact or intent, but that they desire to avoid the economic waste and business disorganization necessarily involved in continuing this litigation, and are willing that a consent decree in the form at-
2381 tached hereto and made a part hereof, be entered herein without conceding or admitting the truth of the facts or matters alleged by the petitioner and without any findings of fact, provided that such consent on their part and the entry of the decree shall not constitute or be considered an admission, and that the entry of such decree or the decree itself shall not be or be considered an adjudication, that they have violated any law of the United States. To such proviso the petitioner assents, because the attached form of decree will provide suitable re-
2382 lief concerning all matters charged in the Petition and not reserved for later determination, and renders an adjudication unnecessary.

2. This cause may be dismissed as to American Telephone and Telegraph Company and Western Electric Company, Inc., who have this day filed their Second Supplement to their answer together with "Substitute License Agreement (B2) and Agreements Relating Thereto" dated July 1, 1932; and may be dismissed as to General Motors Corporation and General Motors Radio Corporation, the last named corporation having gone out of business and the agreements

between General Motors Radio Corporation and defendants, specified in the Petition having been abrogated.

3. General Electric Company and Westinghouse Electric & Manufacturing Company represent that they propose voluntarily to divest themselves of their holdings of stock of Radio Corporation of America by distribution ratably among their own respective stockholders (who, in each case, are very numerous) or otherwise; 2384
but they are unwilling to disassociate themselves from participation in the activities of Radio Corporation of America; and the last named company is unwilling that they should do so, unless such arrangements may be made that Radio Corporation of America is left in what is deemed to be a reasonably sound position, financially and otherwise. Said Companies and the Radio Corporation of America believe that this has been done, the said Companies having made arrangements with the Radio Corporation of America, acting through its directors other than 2385
those of its directors who are connected also with General Electric Company and Westinghouse Electric & Manufacturing Company, that its debts and its real estate commitments shall be substantially reduced as set forth in the attached "Basic Agreement" of even date herewith; that the license relations between the parties be changed from the existing ones to those set forth in the attached "Agreement A-1," and "Memorandum on Foreign Situation," of even date herewith, between Radio Corporation of America, General Electric Company and Westinghouse Electric & Manufacturing Company

and that General Electric Company and Westinghouse Eectric & Manufacturing Company enter into certain agreements, hereto attached, with National Broadcasting Company, Inc., with reference to their broadcasting stations.

It is agreed that it is fair and equitable that periods shall be provided as specified in said consent decree for putting those changes into effect and that the provisions there contained relating thereto are proper. Letter-Agreements
2387 (C-1) to (C-5) inclusive between the parties dealing with operations in said periods are exchanged between them.

The petitioner, by its Department of Justice, has examined all of the Agreements attached hereto, and also the above-mentioned Substitute License Agreement (B2) and Agreements Relating Thereto, and finds no objection to them.

4. Among the Agreements of which the petitioner has complained are various contracts with foreign companies and governments, and the
2388 petitioner in its Amendment to its Amended and Supplemental Petition complains also of the defendants' contention such as that made in a certain Czechoslovakian arbitration. It is recognized that said contention and that all of said contracts with foreign companies and governments present special situations with which the defendants should be afforded an opportunity to deal by negotiation or otherwise. The petitioner, accordingly, does not ask that the decree shall deal with them now, it being agreed that consideration of them be reserved as provided in the attached form of decree.

5. It is agreed that a consent decree, in the form hereto attached, may be entered.

November 21, 1932.

UNITED STATES OF AMERICA
By WILLIAM D. MITCHELL
Attorney General of the United States

JOHN LORD O'BRIEN
Assistant to the Attorney General
of the United States

2390

WARREN OLNEY, JR.
ROBERT L. LIPMAN
HAMMOND E. CHAFFETZ,
Special Assistant to the Attorney General

RADIO CORPORATION OF AMERICA
NATIONAL BROADCASTING COMPANY, INC.
R. C. A. COMMUNICATIONS, INC.
R. C. A. PHOTOPHONE, INC.
R. C. A. RADIOTRON COMPANY, INC.
R. C. A. VICTOR COMPANY, INC.
by CHAS F. CURLEY
Solicitor and of Counsel

2391

CHARLES NEAVE
MANTON DAVIS
STEPHEN PHILBIN
of Counsel

GENERAL ELECTRIC COMPANY
INTERNATIONAL GENERAL ELECTRIC COMPANY
by CHAS F. CURLEY
Solicitor and of Counsel

THURLOW M. GORDON
DARIUS E. PECK
of Counsel

2392 *Plaintiffs' Exhibit No. 42.*

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY

by CHAS F. CURLEY
Solicitor and of Counsel

ROBERT T. SWAINE
WILLIAM D. WHITNEY
of Counsel

2393

Plaintiffs' Exhibit No. 42.

IN THE DISTRICT COURT OF THE UNITED STATES,

FOR THE DISTRICT OF DELAWARE.

2394

UNITED STATES OF AMERICA, Petitioner, against RADIO CORPORATION OF AMERICA, *et al.*, Defendants.	In Equity No. 793.

ORDER OF DISMISSAL.

The petitioner by its counsel having moved that the above entitled cause be dismissed as to the defendants American Telephone & Telegraph Company, Western Electric Company,

Inc., General Motors Corporation and General Motors Radio Corporation, and it appearing that 2395

(1) Since the filing of the Amended and Supplemental Petition herein the agreements therein complained of between defendants American Telephone & Telegraph Company and Western Electric Company, Inc., on the one side, and others of the defendants on the other side, have been modified so as to eliminate therefrom the provisions thereof which said Petition asserted to be unlawful and by reason of which relief was sought against said two defendants, and 2396

(2) Since the filing of said Petition the defendant General Motors Radio Corporation has been dissolved and the agreements complained of in said Petition between the defendants General Motors Corporation and General Motors Radio Corporation and between said defendants and other of the defendants have been abrogated.

Now, therefore, it is hereby ordered that said cause be dismissed as to said defendants American Telephone & Telegraph Company, Western Electric Company, Inc., General Motors Corporation and General Motors Radio Corporation. 2397

Done in open court this 21st day of November, 1932.

JOHN P. NIELDS
District Judge.

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PAGE

PLAINTIFF'S EXHIBIT No. 48
Pierce memorandum, dated December 18, 1912

800

(1)

Dec 18 1912

Efficiency of the Audion

Let I_p = D.C. plate to filament, $I_{p(a.c.)}$ = alter. cur.
I_c = D.C. grid to filament $I_{c(a.c.)}$ " "
E_p = Voltage plate to filament $E_{p(a.c.)}$ = A.C. Potential
E_c " " grid to filament $E_{c(a.c.)}$ = AC. "
R_p = Resistance plate to filament $R_{p(a.c.)}$ = AC. Resist.
R_c " " grid to filament $R_{c(a.c.)}$ = AC. "
m, n, A, A_0 = Constants for individual audions determined by curves or D.C. tests
A, n = variable - function of $V_c + V_p$

Input Impedance m (from curves) { Audion-74 $I_c = 8\,V_c^{4.22}$

(1) $I_g = A_0 E_g$

$$R_{g(a.c.)} = \frac{d E_g}{d I_{g(a.c.)}} \quad \text{(approximately)}$$

(2) From (1) $R_{g(a.c.)} = \frac{E_g}{m A_0 E_g^n} = \frac{E_g^{1-n}}{m A_0}$

(2) $R_{g(a.c.)} = \frac{E_g^{1-n}}{m A_0}$

But from the curves it is assumed that the current perfectly rectifies and only the positive $\frac{1}{2}$ of the current flows so that

(3) The apparent $R_{g(a.c.)} = \frac{2 E_g^{(1-n)}}{m A_0}$

Input voltage = $E_{g(a.c.)}$ $\quad E_{g(a.c.)} = .707\, E_{g(max.)}$

Input Energy $= \frac{E^2_{g(a.c.)}}{\text{appar. } R_{g(a.c.)}} = \frac{E_g^{(1+n)} m A_0}{2 E_g^{(1-n)}}$

$$= \frac{.707 E_{g(a.c.)}^{(1-n)} m A_0}{2 \cdot E_{g(a.c.)}^{(1-n)}} \quad \text{(max. to d)}$$

Input Energy $= \frac{.707\, m A_0 E_{g(a.c.)}^{(1+n)}}{2}$

Pierce 43

650-175

3

(2)

Output Impedance

$I_p = A E_p^n$ (from curves $\begin{cases} \text{Audion } 7A \\ I_b = \left(\frac{4.15(V_c+11)}{V_c+30.}\right) E_b^{\left(\frac{.03 V_c}{V_c+10}+1\right)} \end{cases}$

where A and n are functions of V_c and V_b

$R_{p(ac)} = \frac{dE_p}{dI_p}$ approximately $\frac{E}{I}$

$R_{p(ac)} = \frac{E_p^{1-n}}{nA}$

Output Energy

With $R_{ext} = 0$

$\text{Energy} = \frac{E_{max}^2}{R_{p(ac)} + R_{ext}} = \frac{E_p^2}{R_{p(ac)}}$ (all unavailable)

With $R_{ext} = R_{in}$

$\text{Energy} = \frac{E_p^2}{2 R_{in}}$ $\frac{1}{2}$ of which is unavailable

$\text{Available Energy} = \frac{E_{p(ac)}^2}{4 R_{p(ac)}}$

$E_{p(ac)} = R_{p(ac)} I_{p(ac)}$ $(n \neq 1)$

$\text{Energy} = \frac{I_{p(ac)}^2 E_p}{4nA}$

To obtain $I_{p(ac)}$

Let change of current due to reversing grid volts E_g be called ΔI_p

$\Delta I_p = f_1(E_g)$ from curves $\begin{cases} \text{For 7A audion} \\ \Delta I_p = (3 E_p + .20) E_g \end{cases}$

$I_{p\,ac} = \frac{\sqrt{2}}{2} \frac{\Delta I_p}{2}$ $E_{g(ac)} = .707 E_g$

$= \frac{.707}{2} \Delta I_p$

$I_{p\,ac} = \frac{.707}{2} f_1[E_{g(ac)}]$

$\therefore \text{Output Energy} = \frac{1}{4}\left[\frac{.707}{2} f_1(E_{g(ac)})\right]^2 \frac{1}{nA} E_p^{(1-n)}$

$\text{Efficiency} = \frac{2 E_p^{(1-n)} [f_1(E_{g(ac)})]^2}{.707^2 6\, n\, m\, A\, R_0\, E_{g\,ac}}$

$$Eff. = \frac{2 E_p^{(1-n)} \left[f_1(E_{g-1}) \right]^2}{.707 \sqrt{6} \; n \; m \; A \; A_0 \; E_{g-1}^{(n+1)}}$$

$$f_1(E_{g-1}) = (3 E_b + 20) E_{g+1}$$

$$A_0 = 8$$

$$m = 1.22$$

$$A = \log^{-1}\left(\frac{4.15(V_c+1)}{V_c+30.5}\right)$$

$$n = \frac{53.2}{V_c+30.5}$$

For Audion 7-A

$$\therefore Eff. = \frac{(3 E_b + 20)^2}{55.2 \left(\frac{53.2}{V_c+30.5}\right) E_p^{\left(\frac{53.2}{V_c+30.5}-1\right)} E_c^{1.22} \log^{-1}\left[\frac{4.15(V_c+1)}{V_c+30.5}\right]}$$

E_c .1

$$\frac{121^2}{55.2 \left(\frac{53.2}{30.6}\right) 30^{\left(\frac{53.2}{30.6}+1\right)} .1^{1.22} \log^{-1}\left[\frac{4.15(1.1)}{30.6}\right]}$$

$$= \frac{121^2 \cdot 1.66}{96.2 \cdot 12.31 \cdot 1.41} = \underline{16.9}$$

.8

$$\frac{12100}{55.2 \left(\frac{53.2}{31.3}\right) 30^{\left(\frac{53.2}{31.3}+1\right)} .8^{(2.7)} \log^{-1}\left[\frac{4.15(18)}{31.3}\right]}$$

$$= \frac{12100}{93.8 \cdot 30^{(0.7)} \cdot .8^{(2.7)} \log^{-1} .239}$$

$$= \frac{12100 \times 1.05}{9.25 \times 10.5 \times 1.73} = 7.25$$

2.

Sub. 131 $\underline{5.4}$

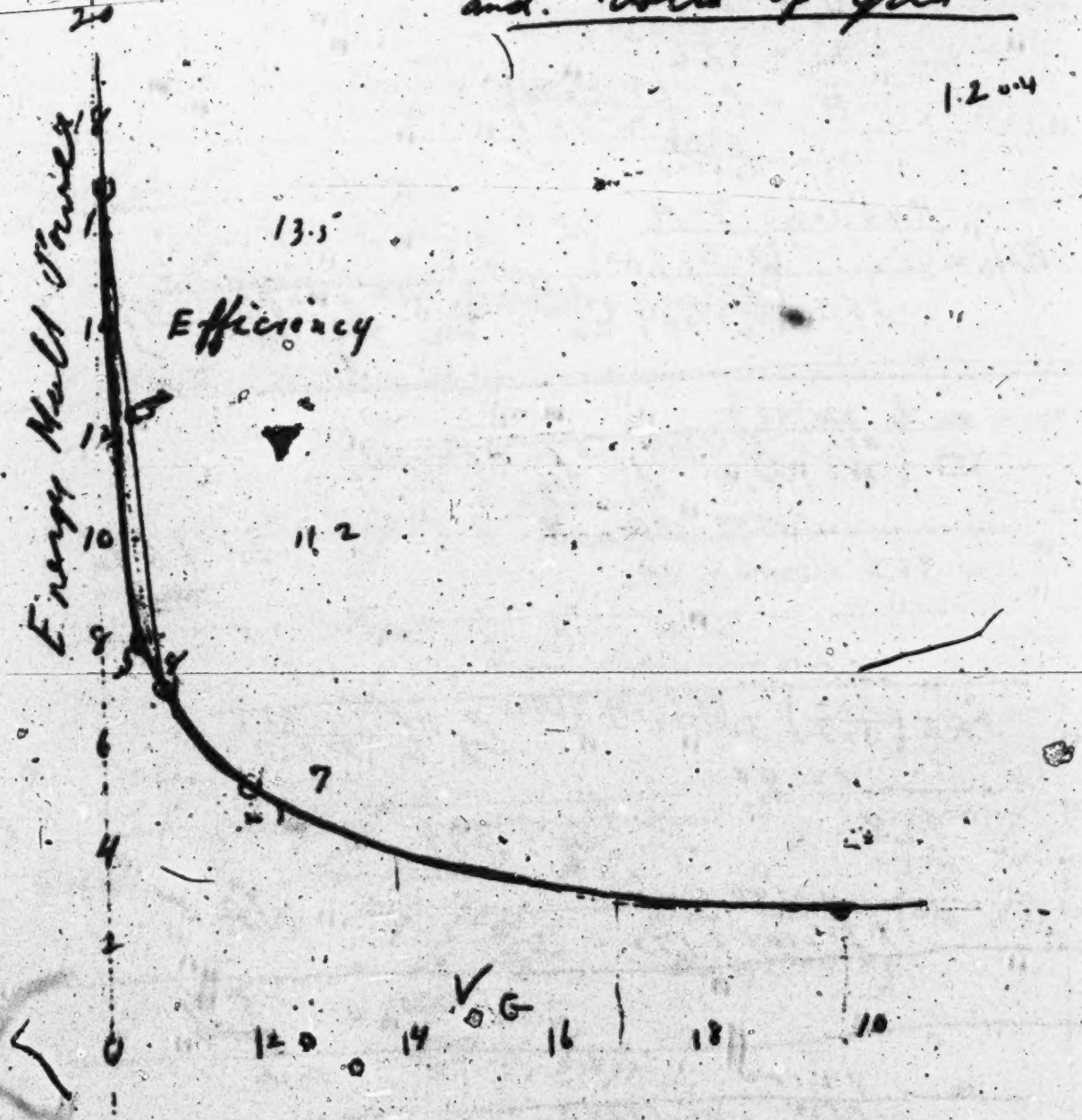
10

$$\frac{121^2}{55.2 \left(\frac{53.2}{10+30.5}\right) 30^{\left(\frac{53.2}{10+30.5}\right)} 10^{1.22} \log^{-1}\left(\frac{4.15 \times 11}{40.5}\right)}$$

$$\frac{121^2}{72.5 \cdot 30^{(.312)} \cdot 10^{(1.22)} \cdot \log^{-1} 1.126}$$

$$\frac{121^2}{72.5 \cdot 2.9 \cdot 1.66 \cdot 13.4} = \underline{2.59}$$

Relation between Efficiency or Energy Multiply Power and Volts of grid.



$$\boxed{Eff = f(E_b)}$$

$$Eff. = \frac{(3E_b + 20)^2}{55.2\left(\frac{53.2}{V_c + 30.5}\right) E_b^{\left(\frac{53.2}{V_c + 30.5} - 1\right)} E_b^{\cdots} \log^{-1}\left(\frac{4.15(V_c + 4)}{V_c + 30.5}\right)}$$

Let $V_c = .5$ volt

$$Eff = \frac{(3E_b + 20)^2}{946 E_b^{0.71} \cdot 857 \cdot 1.54} = \frac{(3E_b + 20)^2}{129 E_b^{0.71}}$$

Let

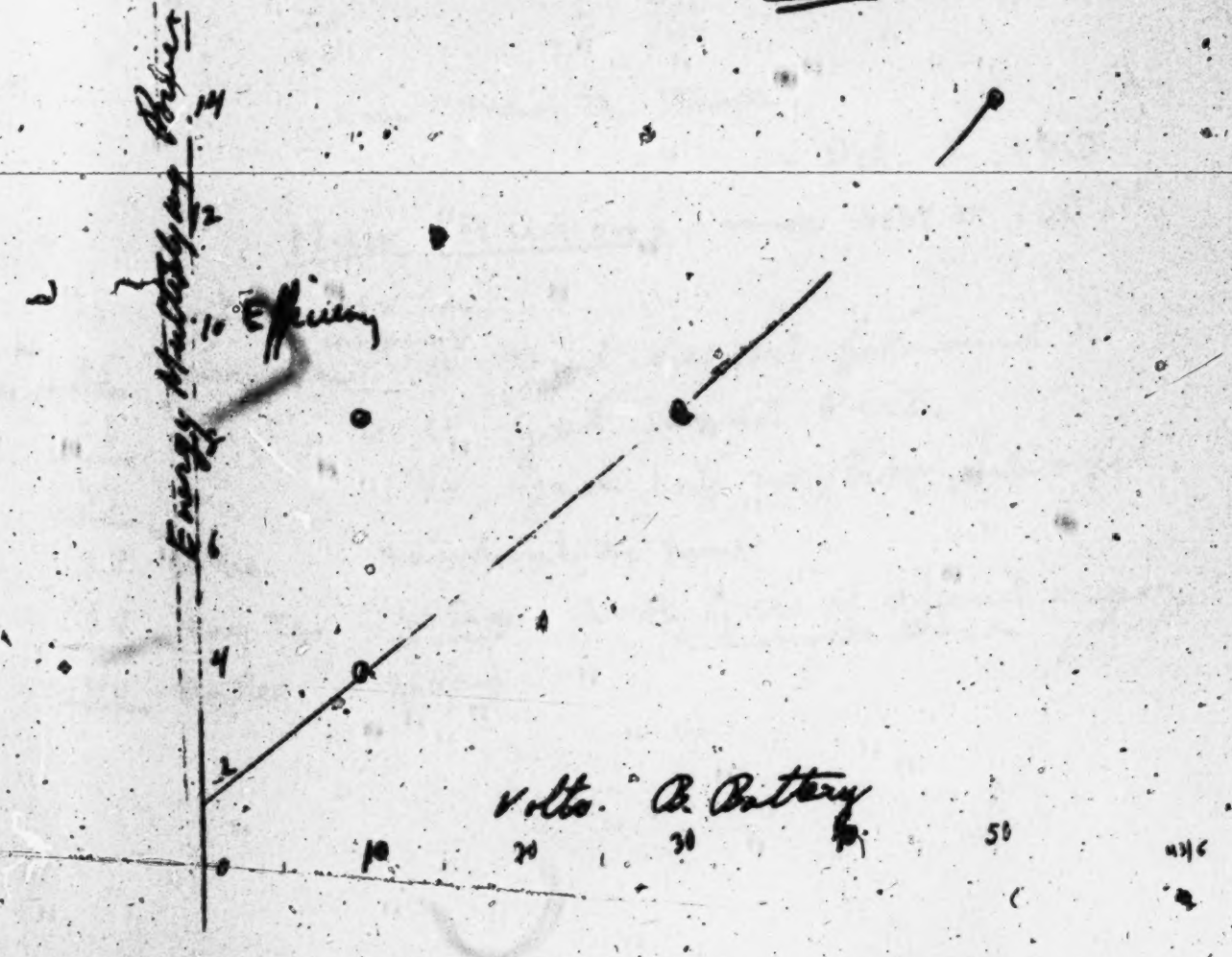
$V_p = 30$ $\quad \frac{12100}{129 \cdot 1635} = 8.28$

$V_p = 10$ $\quad \frac{2500}{94.6 \cdot 10^{0.71} \cdot 857 \cdot 1.57} = \frac{2500}{129.0 \cdot 10^{0.71}}$

3.78

$V_p = 50$ $\quad \frac{28900}{129 \cdot 50^{0.71}}$

13.88



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PAGE

PLAINTIFF S' EXHIBIT No. 44.

Page 190 of Pierce's Notebook No. 20

Oct-2, 1913

Audion A-7.1

Effect of E_c

I_f	E_f	E_B	E_c	Gain	I_B	Remarks
1.35	27	90	0	24	370	Blue haze in all cases
"	"	"	155	23	710	
"	"	495	265	20	916	
"	"	453	"	19	700	
"	"	545	"	19	860	
"	"	63	"	18	920	
"	"	50	4.	9	820	
"	"	40	"	8	600	
"	"	60	"	8	901	
"	"	30	5.5	-8	870	
"	"	40	"	-3	740	
"	"	30	"	+3	540	
"	"	20	"	6	400	
"	"	60	"	-8	800	

Gain Audion to Thermal.

Oct. 2, 1913

New Audions made Sept 30 + Oct 1st.

No	Coat.	Max. Curr.	
35	Heavy Ta	1.5 on pump	Grid nearest filament
36	"	" 1.5	Grid nearest Plate
37	"	" 1.5	Grid half way between plate + fil.
38	Ba Rea	Burnt out on pump	
39	Heavy Ta	1.5 5.6 amp	Loop Grids of different sizes.
40	Ba Rea.	1.65 amp	

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PLAINTIFF'S' EXHIBIT No. 45 806

Page 55 of Notebook No. 36

AUDION 39

DESCRIPTION.



A = B = PLATE

C = GRID
(Composed of a wire-loop with no network between)

D = GRID
(Like C but some what smaller)

F = FILAMENT.
(Heavy Tantalum)

PLAINTIFF S' EXHIBIT No. 46
Page 59 of Notebook No. 36

COPY OF REPORT

PLAINTIFFS' EXHIBIT NO. 46
Notebook 36, page 59.

Oct. 10 1913

At the request of Mr Kendall for information on the input resistance of the gaseous ionization chamber and the question as to whether any variation in the resistance of the input with various values of "C" battery. The resulting curves are shown on plane sketch sheets marked II, III, IV and V — tubes 15.1 A.C.1, A.9.111 and 23.11 respectively. Two kinds of variation are noted. In tubes 15.1 and A.9.111 there was a general decrease of resistance for increase of input while in A.C.1 and 23.11 the reverse took place. In the first instance the readings had a crystal glow while in the latter they did not. A probable explanation of this relation of input and resistance is as follows — where blue haze fills the tube the resistance is stable. As the input or the grid is increased the blue haze is drawn to the plate and less remains between the grid and filament and hence the increase in input resistance. A tabular summary is given on sheet marked VII.

Also a test was made on Audion 96 to ascertain the comparative effect on efficiency of a "C" battery and a plug variable across the input leads. A preliminary test was made to determine the best value of external resistance to be used in output side. Trials were made with 2 plug lib current with "C" battery and with shunt resistance.

The plotting on ES 93921 shows 4000 ℧ to be a very good value for all cases and this value was used.

Then data was taken to determine the output and efficiency of the audion values — with 3 plug lib current with "C" battery of 7.4 volts and with shunt resistance of 20000 ohms. This latter value was selected as the one which caused the least reduction in the range of input values the same shunt resistance as that produced by the C battery of 7.4 volts. The results are plotted on ES 93922. The results between with the "C" battery shunt resistance and shunt resistance gave about identical curves with a slightly better efficiency for latter.

16

12/15/43

Anodes received 12/13, 28 m

Anodes No	Fil. Coating	
155	Sr(OH)$_2$+BaRes+Sr(OH)$_2$+BaRes	
157	" " " "	
158	" Ba Res.	

Pump Record
Time of heating = 2.6 hours
Max I_f = 1.7 amp
Vacuum = 75.95
Heat = 465°7 for 5 min
Filaments glowed 45 min

Blue haze on #155 at 110 V.
(crack in squeeze)

* 158 (special) 12/13 ES-111724

Pt. Twist. BaRes-K

Tame.	E_f.	I_f.	E_c.	E_g.	I_g.	Gas.	Remarks
				(Side A + Side B)			
3 cp	2.85	1.5	0	40	2	open	constant
				55	2.5		
				70	3.0	⊙	
				85	73		
				100	97		
			1.4	40	30		
				55	57		
				70	83		
				85	107		
				100	119		
			2.75	40	62		
				55	87		
				70	108		
				85	124		
				100	137		

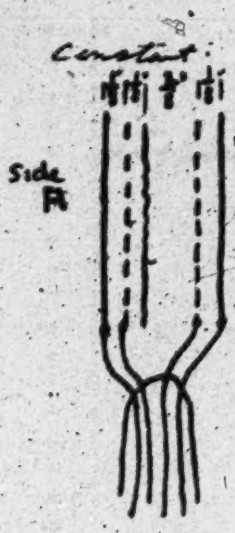


Plate + grid + bulb size ∠ Standard see p. 6.

				(Side A)			
3 cp	2.85	1.5	0	40	1.	open	
				55	10		
				70	24		
				85	43		
				100	635		
			1.4	40	13		
				55	28		
				70	47		
				85	65		
				100	82		
			2.76	40	32		
				55	52		
				70	70		
				85	85		
				100	98		

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PAGE

PLAINTIFF'S EXHIBIT No. 98

Pages 56 and 57 of Notebook No. 50

Cudion #2

Date	Hour	E_p	I_p	E_L	L_p	L_p	Remarks
1/5		Incs	1	0	10	8.	4 pm Steel Chimney Pot
					25	170	"
					40	220	"
					55	240	"
					100	240	"
		2.3	1.25	0	15	145	"
					30	400	"
					45	2150	"
					60	3250	"
					75	4500	"
					100	5400	→ " dropped to 450v Blue Flame
1/6	10	2.35	1.25	0	10	50	" Owl Light & 1.4 amps. for 10 hrs.
				0	15	200	"
				0	20	420	"
				0	26	765	"
				0	30	1080	"
				0	35	1510	"
				0	50	2800	"
				0	65	4500	"
				0	80	5700	"
				0	100	6100	" dropped to 5 pm
		2.8	1.4	0	10	80	"
				0	245	830	"
				0	40	2420	"
				0	55	4100	"
				0	70	5450	"
				0	85	8200	"
				0	100	10500	"
		2.8	1.4	1.4	10	170	"
				1.4	25	1065	"
				1.4	40	2800	"
				1.4	55	4600	"
				1.4	70	6600	"
				1.4	85	8800	"
				1.4	100	11100	"
		2.8	1.4	2.8	10	235	"
				2.8	25	1215	"
				2.8	40	3250	"
				2.8	55	4900	"
				2.8	70	6900	"
				2.8	85	9100	"
				2.8	100	11500	"
		2.8	1.4	0	25	840	19
			1.4	0	40	2450	21
					55	4150	22
					70	6050	22
					85	8200	22
		2.8	1.4	1.4	25	1020	18
					40	2700	21
					55	4500	21
					20	620	18

57

Carbon #235 continued from P. 55

Date &	E_1	I_1	E_2	E_3	I_3	Watts	Remarks.
1/6	2.0	1.4	0	25	150	19	
	2.0	1.4	0	40	440	25	
	2.0	1.4	0	55	1040	26	
	2.0	1.4	0	70	1900	27	
	2.0	1.4	0	80	2500	27	
	2.0	1.4	0	100	2300	27	
	2.0	1.4	0	85	2000	27	
	2.0	1.4	1.4	25	150	24	
	2.0	1.4	1.4	40	450	24	
	2.0	1.4	1.4	55	1040	27	
	2.0	1.4	1.4	70	1900	27	
	2.0	1.4	1.4	85	2000	26	
	2.0	1.4	1.4	25	150	20	E_2 value not correct.
	2.0	1.4	2.0	40	440	24	
	2.0	1.4	2.0	55	1040	24	
	3.1	1.5	0	25	150	17	
	3.1	1.5	0	40	500	22	
	2.0	1.4	0	40	440	23	
1/8	2	Other	instruments		Tests by	Meades.	
	2.05	1.4	0	65	1240	27	
	2.05	1.4	0	70	1400	27	
	2.05	1.4	0	60	2000	26	
	2.05	1.4	1.4	55	1250	27	
	2.05	1.4	1.4	70	2000	27	
	2.05	1.4	1.4	80	2500	27	
	Quite	steady		output.			
	2.05	1.4	1.4	70	1600	26	
	2.05	1.4	1.4	75	1900	27	
	2.05	1.4	1.4	85	2400	27	
	2.05	1.4	1.4	100	3400	27	
	Quite	steady		output.			
	2.05	1.4	1.4	100	3100	15	
	2.05	1.4	1.4	85	2400	17	
	2.05	1.4	1.4	75	1900	17	
	2.05	1.4	1.4	65	1600	17	
	2.05	1.4	1.4	60	1400	15	
	2.05	1.4	1.4	70	1700	17	
	2.05	1.4	1.4	80	2000	19	
	2.05	1.4	0	100	3000	20	

PLAINTIFF'S EXHIBIT No. 46

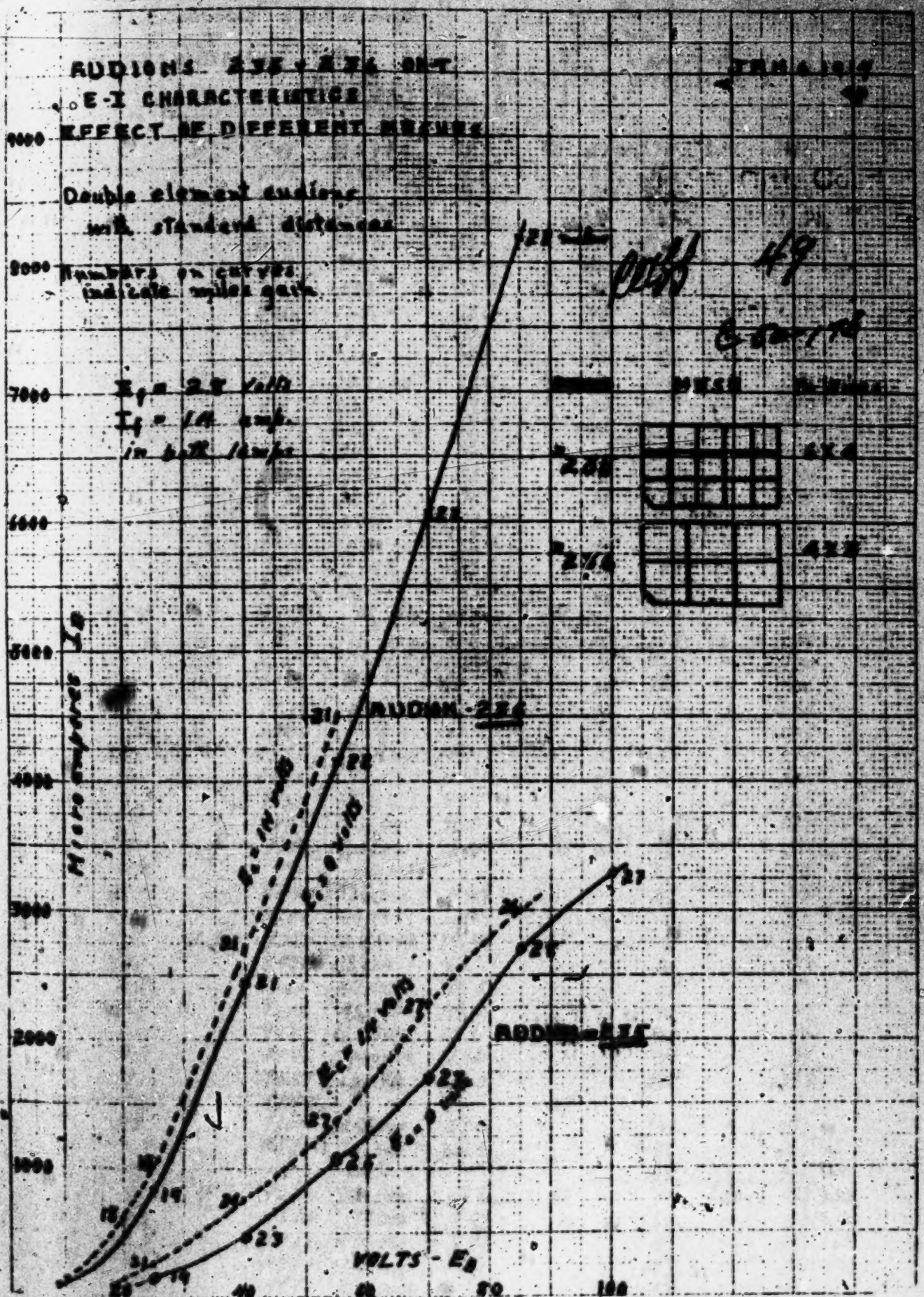
Sketch 251111730, dated January 6, 1914

811

Bk 50 p. 66-67

WESTERN ELECTRIC COMPANY, NEW YORK, U. S. A.
ENGINEERING DEPARTMENT

Sketch No. ES 111730



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PAGE

PLAINTIFF'S EXHIBIT No. 80

'73

Page 72 of Notebook No. 80

Feb. 5, 1913

Audeon S.S.

Fil. Current = 35 amps

(Data taken Feb. 1 to 5 inclusive by Nicolson & Shaw)

No.	Input C.B.H	Input V.	Input R.C	Input R_s	Input R_x	Input Power	Output S.B.H	Output Est. R	Output Current DEFIE	Output Current SHUNT	Output I
1	0	3	9204	145,000	72.3	40	5	000 2.10	600		39.3
2			9171	111.	81.8		10	181	"		345
3			9170	113.	79.5		15	157	"		385
4			9210	116.5	72.3		20	139	"		302
5			9150	129.3	73.0		25	102	"		270
6			9250	128.3	73.0		30	88	"		247
7			9250	128.8	73.0		35	78	"		222
8			9260	125.	72.0		40	68	"		222
9			9250	129.	69.8		45	55	"		193
10			9280	129.	69.8		50	42	"		170
11	-1.4	3	9840	207,000	45.5	40	5	240	"		378
12			9580	128.	39.5		10	158	"		340
13			9595	237	38.0		15	121	"		300
14			9610	342	36.6		20	101	"		270
15			9620	352	35.6		25	86	"		245
16			9630	360.	34.6		30	72	"		223
17			9645	272.	33.1		25	64	"		209
18			9645	270.	33.4		40	59	"		198
19			9660	284.	31.7		45	48	"		180
20			9665	250.	32.1		50	41	"		168
21	+1.4	3	8815	74,300	121.	40	5	240	"		378
22			8840	76,300	118.		10	158	"		340
23			8880	79.4	113.2		15	121	"		300
24			8910	81.7	110.		20	101	"		270
25			8930	83.4	108.		25	80	"		245
26			8945	84.9	106.		30	69	"		219
27			8951	85.9	104.		35	58	"		199
28			8996	89.	101.		40	47	"		170
29			9020	92.	97.8		45	37	"		160
30			9035	93,500	96.0		50	28	"		138
41	0	.5	9300	134,000	1.88	35	35	19	00		50
42	-1.4			"			"	27	"		58
43	+1.4		8420	53,900	4.69		"	27	"		58
44	+2.8		8270	47,800	5.24		"	8	"		31
45	0	1.5	9280	129,000	17.45	35	"	41	"		72
46	1.4		8430	53,600	42.		"	21	"		53
47	2.8		8260	47,400	47.5		"	18	"		49
48	4.0		8210	45,900	49.0		"	15	"		44
49	-1.4		9940	165,500	13.6		"	60	"		88
50	-2.8		9945	2,000,000	1.12		"	44	"		71
51	0	3.	9240	131,500	74.5		"	578	"		193
52	0		9240			35	"				
53	-1.4		9600	244,000	37.5		"	342	"		157
54	-2.7		9815	734,000	12.3		"	195	"		196 161
55	-4.			"			"	108	"		108 134
56	0	4	9220	118,000	134.	35	"	74	600		224
57	-1.4		9510	194,000	8.45		"	63	"		212
58	-2.7		9760	404,000	3.85		"	39	"		164
59	-4.		9915	1,165,000	1.37		"	27	"		135
60	-5.4		9991	999,000	1.6		"	13	"		96
61	+1.4		8820	92,600	21.2		"	60	"		209
62											

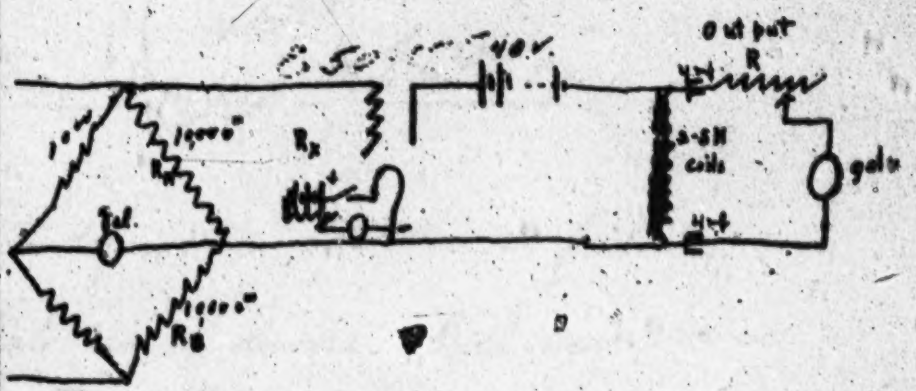
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PAGE

813

...stage across R₂ = 8.4
with negative terminal of Batt to common point

Power I R out	Gain (Percent Power In)
778.	9.89
1.33.	16.25
1680.	21.2
1.825.	23.6
1.820.	24.9
1.830.	25.1
1.825.	25.8
1990.	27.6
1.790.	25.7
1.620.	28.2
7730.	17.8
1.155.	29.2
1.350.	33.5
1.460.	40.
1.500.	41.
1.490.	43.
1.530.	463.
1.570.	47.
1.555.	49.4
1.580.	49.2
2.720.	6.39
1.155.	9.8
1.350.	11.9
1.460.	13.3
1.321.	12.8
1.440.	13.6
1.380.	13.3
1.445.	14.3
1.230.	12.6
1.070.	11.2
824.	48.4
1180.	0
1120.	25.2
336.	6.42
1.220.	10.4
98.1	2.33
84.0	1.77
67.6	1.36
277.	20.4
416.	19.5
1.305.	12.2.
1.225.	12.7
[illegible]	[illegible] 73.
[illegible]	0
[illegible]	13.4
[illegible]	19.8
[illegible]	23.8
[illegible]	46.7
[illegible]	96.1.
[illegible]	7.1



All the experiments here to fore the A. Batt. negative terminal was the common point.

ES-Sketches E 1313
~~E 1314~~
E 1315
E 1316

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PAGE

PLAINTIFF'S EXHIBIT No. 82
Dr. Arnold's memorandum, dated March 15, 1914

Mr. Arnold

Mar. Melick March 9, 1914

The induction coil as detector.

I define a detector as follows:
"A detector is a device which can be so associated with an instrument insensitive to currents of wireless frequencies as to cause it to respond to wireless signals"

In the receiving antennae of a wireless station are generated E.M.F.s oscillating at frequencies greater than 50,000 per sec. The detector is usually so associated with the antennae that across it are impressed oscillating E.M.F.s of the same frequency as occur in the antennae. Suitable variations in the amplitudes of these oscillations constitute the signal. In general signals consist of groups of

oscillations of nearly constant amplitude spaced by groups of nearly zero amplitude. I shall consider this class of signals only, but the same remarks will apply with proper changes in terminology to signals consisting of variations of amplitudes, the amplitudes never becoming zero. The discussion does not apply to the case where the detector is acted upon by high frequency E.M.F. of steady amplitude, the frequency being varied to produce the signal.

Neglecting devices for tuning etc. there are two typical circuit in use with the audion.

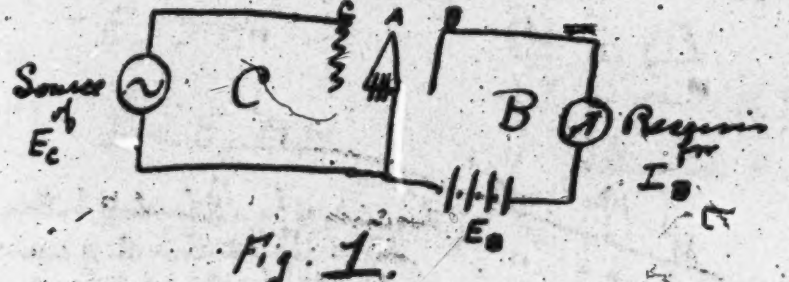


Fig. 1.

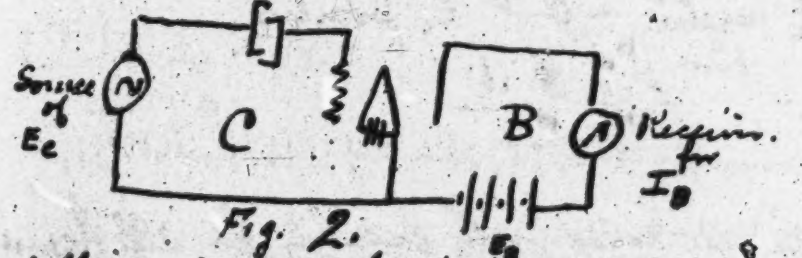


Fig. 2.

These differ only in the presence of a condenser in circuit 2.

Discussion of Circuit 1.

The following is a typical curve of the relation between current in the B side and potential impressed on the C side.

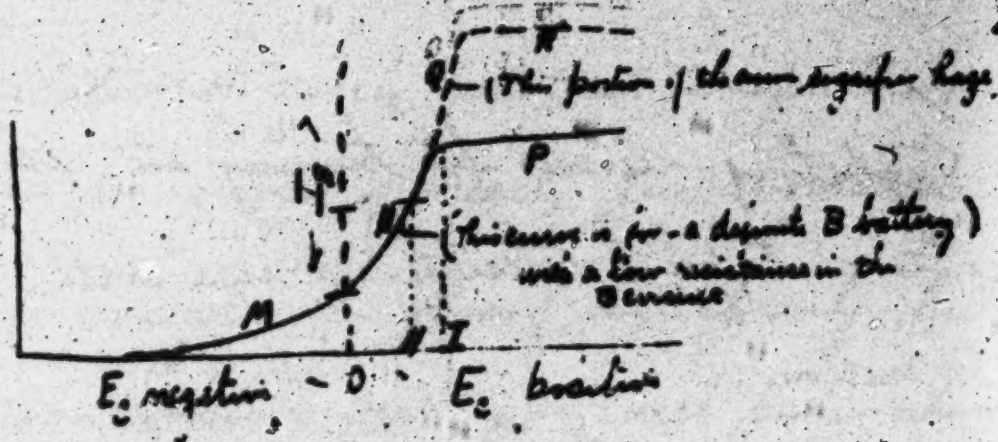


Fig 3. (a)

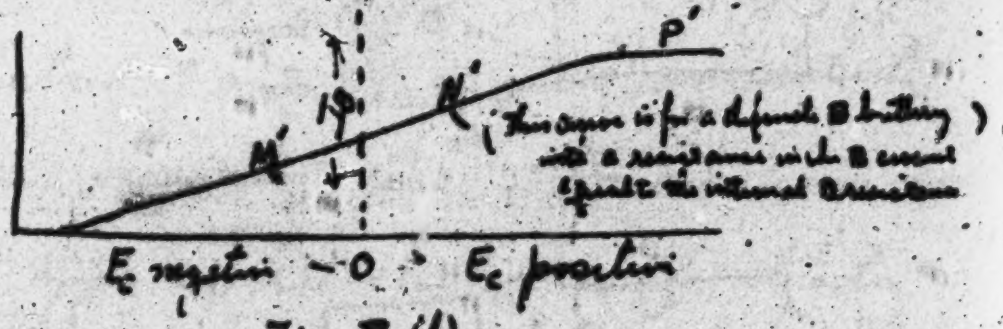


Fig 3. (b)

These curves are stored with facility for all frequencies of E_c which have been investigated, and deductions from physical data and requirements at command that no great deviation will be found up to frequencies of the order of 10,000,000 per sec.

(Note: The bending of curve Fig 3(a) at curve Fig 3(b) is caused by the drop in potential through the B resistance, and the corresponding distance in R.S. between R and A, are the 3 voltage indications B current measures)

Fig 3(a) shows oscillations in various conditions
2. mainly arising detector operation.
Fig 3 shows the following conditions:

(I) $E_c < H$ $\{H$ is value of E_c at which I_0 becomes down to its normal value$\}$

(II) $E_c > H$

(III) $I < E_c < H$ $\{I$ is value of E_c at which detection begins.$\}$

(II) The effect of charge

(I) $E_c < H$.

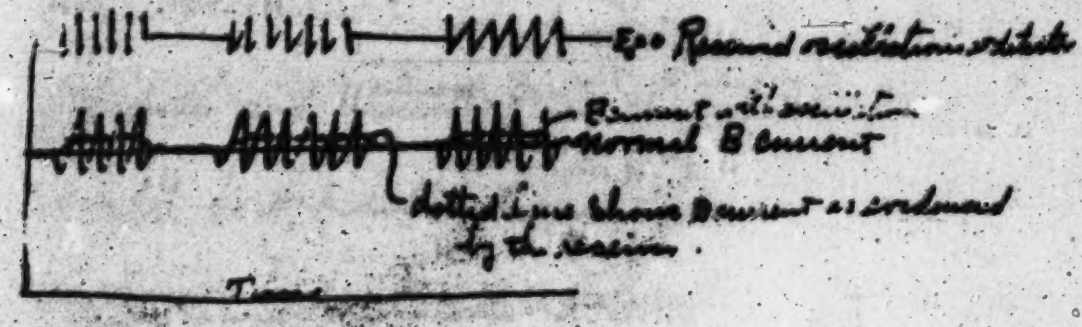


Fig 4.

Fig 4 in connection with the above Fig 3(a) shows without further explanation the operation in this case

(II) $E_c > H$

This differs from the preceding in magnitude of effect only. If E_c extends beyond the value at which saturation begins the device becomes less efficient as E_c is further increased.

(III) $I \leq E_c < H$

To avoid confusion I will discuss next curve.

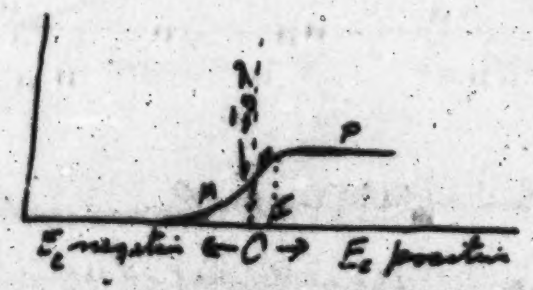


Fig 5.

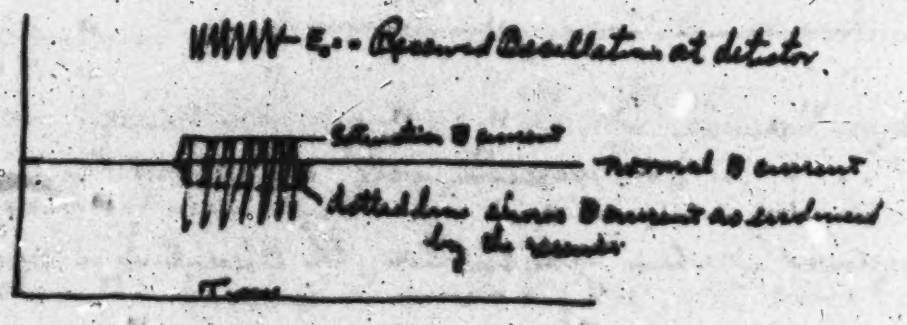


Fig 6.

The method of operation can be deduced from the curves.

(IV) The effect of charge.

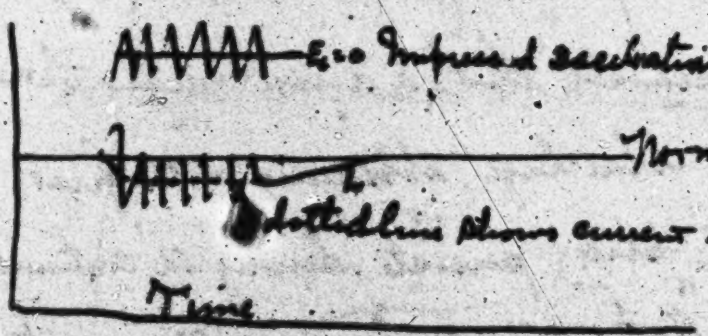
If charge be put into either effectively terminal station as a detector, being equivalent to a shunt between A B and C.

If charge occurs only at the positive phase of the C waves operation proceeds as in (I)

It is conceivable that a device might be made that blue charge, appearing on the first positive Ec bank, persists during the continuance of the oscillation period, lowering the resistance of the path and increasing the B current. This would be but little different from (I) and need not be further considered.

Discussion of Circuit 2.

The first positive kick of the impressed oscillations may cause the collection of electrons on C, which having no way of escape inside the bulb can only be dissipated by external leakage



The leakage factor L will have an extension in time directly proportional to the leakage resistance. By properly proportioning the leakage this (B current) may be made to return to a normal condition in time for the next group of oscillations.

In any event, even with high leakage resistance, the groups of waves will be evidenced, step by step, by decrease in the B current.

7. 9

Conclusion:

The receiver can only indicate signals if th' current thru it decreases or increases for every group of oscillations.

(a) The current always increases with a group of oscillations.

Circuit 1 (I) & (II)

(b) The current may decrease with a group of oscillations

Circuit 1 (III)

Circuit 2

The best of these is the way in which the Audion functions, as usually connected for wireless telegraph receiving..

H. D. Arnold

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PLAINTIFF'S' EXHIBIT No. 88

Pierce's memorandum, dated March 19, 1914

Mr Arnold.

This report is merely a compilation of data obtained with different grids. It is written up to let those interested know just what work has been done.

O.H.P.

March 19, 1914

Experimental Audions

Grid Distance Work 53

650-175

In a report of Oct 16, 1913 an experiment was described in which an audion having different grid distances on either side of the filament was tested. The grid which was the closer to the filament showed the better results. See ~~Ex~~. Sketch No. ES. 93579. In a later audion the grid distance on Side A was made $\frac{3}{32}$ and the plate distance $\frac{6}{32}$"; and on Side B, the grid distance $\frac{9}{32}$" and the plate distance $\frac{12}{32}$", the grids being the same distance away from their respective plates. The results from the lamps are recorded on E.S. 111740. Side A having the closer plate and grid distance gave read the larger space currents and gains for any given plate voltage and also greater gains for equal space currents and different plate volts.

Grid Opening

A series of tubes was made to determine the best size of mesh to be used at a given grid distance. Four ten audions were constructed in seven pairs. They were operated in pairs or in Ts for the sake of comparison and elimination of the question of vacuum. They were all double element audions some of which had different grids on the two sides of the filament.

2.

In all the tubes the bulbs were 2½" diameter, the plates ½" apart and the grids 7/32" apart. The plate size was 1⅝" x ⅝". The filaments were platinum twist coated with barium resinate.

The first series of experiments on these audions was the determination of the gains and $E_B - I_B$ characteristics for a one-way standard audion circuit in which the high side of the input transformer was designed to work into 30,000 ohms and the high side of the output transformer into 35,000 ohms. As the input and output resistance of the audions with different meshes varied considerably the comparison of efficiency of the different meshes on the testing circuit is only approximate. The numbers on the E-I curves indicate the miles gain obtained at the particular values of E_B and I_B.

Sketch ES 111739 shows the curves obtained from data using meshes shown on the sketch. The large mesh gave the greater space current and greater gain. Sketch ES 111729 shows the results for six audions having special meshes on one side of the filament and standard grids on the other side. These curves show that the larger meshes allow greater space currents and greater gains. These curves were obtained with a grid voltage of +14 volts. The characteristics with $E_c = 0$ are shown in ES 111732 and show more clearly that the 7X5 wire and 6X4 wire mesh are better than the 10X6 and 8X5 wire mesh.

The difference in the 7x5 wire and 6x4 wire meshes were not apparent from these curves, therefore two audions were made on a T having in one a double element 7x5 wire mesh and in the other 6x4 wire mesh. The results of this pair of tubes are shown on Sketch ES. 111735. The space current (Ig) for the larger mesh is the greater but the gains are practically the same. When we consider that the output resistance of the tube with the 6x4 mesh is 21,000 ohms and that the tube with the 7x5 mesh is 33000 ohms which is the proper resistance for the output transformer used, it may be that the 6x4 mesh is the more efficient. Sketch ES-111736 shows the $E_c - I_g$ and $E_c - I_c$ characteristics for these two tubes.

Two more pairs of tubes were constructed one tube of each pair having 6x4 meshes and the other tube of each pair having 7x5 wire mesh. The resulting curves from these tubes are shown on Sketch ES. 111737 and 111738. It is quite apparent that the smaller mesh (6x4) is the better.

A second series of experiments were made on some of the audions previously described, in which the absolute efficiency was measured in a testing circuit such as shown in Sketch ES-111735. The input and output impedances of the audions to 1000 ~ A.C. were measured in a carefully shielded bridge. The input A.C. voltage was maintained constant and the output current through a resistance equal to the output impedance

measured on a Weddell Thermal Galvanometer. In order to measure the input impedance with any degree of accuracy a positive C battery of 1.4 volts was used. The same or greater efficiency could be obtained with a C battery of negative 2.8 volts by boosting the B battery voltage to obtain the same space current as with positive C battery.

ES-115522-A, E.S. 115523, and ES 93939 show curves for input impedance, efficiency, and output impedance for varying B battery voltage, of audions with several different meshes. The results bear out the conclusions reached from the talking circuit tests and indicate that the 8X4 mesh is more efficient than the 4X3 and 7X5 meshes.

At the request of Mr Van der Bijl three audions were made on a T alike in construction having 7X5 meshes of different diameter wire. They were tested on the talking circuit and on the bridge circuit. The results are recorded on Sketch ES 115523 ~~and on~~ ES 93940. Both tests indicate that the .008" wire is a better size of wire to adopt than the .015" or .001" on the particular construction used.

Sketch B shows the efficiency of an audion of standard B construction, that is having an 8X2 mesh.

Sketch C. shows the efficiency of several audions especially designed to handle large energy.

H. Pierce

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PLAINTIFF'S EXHIBIT No. 54

Dr. Arnold's memorandum to Mr. Colpitts, dated April 17, 1914

Audion Amplifiers without Transformers

April 17, 1914.

MR. E. H. COLPITTS:

This relates to the use of audions as amplifiers in circuits from which it is advisable to exclude transformers. Among such circuits may be noted:

1. Those in which the frequency is so low that efficient transformers are costly and difficult to design. (This includes telegraph circuits; land, submarine and wireless).
2. Those in which an exact reproduction of wave form is necessary for legibility (e.g. cable telegraph circuits).
3. Those in which undistorted amplification must be secured over a wide range of frequencies, (e.g. in the reproduction of speech and music), in which cases the inherent selectivity of a transformer is undesirable.

With the audion at present on the market, transformers must be used to secure appreciable amplification. This is especially true when amplification is desired in circuits of low impedance.

The explanation for this is found in the characteristics of the audion itself. The impedance of the input side of an audion operating efficiently is greater than 100,000 ohms and it does not appear that any practical structural change can

much reduce this. Hence, if it is desired to secure amplification in a circuit of, say, 1000 ohms impedance, at least 90% of the possible current amplification must be lost if no transformer is used.

Moreover, with the present commercial audion structure the impedance of the output side is always so great that a considerable loss of possible amplification must occur if we attempt to operate without transformers into a line of impedance of the order of 1000 ohms.

It has been found possible to construct audions with any desired output impedance, but no modification of this kind has produced a single-audion structure which will operate to advantage in low impedance circuits from which transformers are excluded.

Obviously an attempt might be made to use several audions, the one operating into the next, etc., in the hope that by such a succession of devices the output and input losses noted above might be so far overcome as to render the complete operation of value.

Various attempts at so-called "cascade" operation have been made by DeForest and others, but never, so far as I am informed, in circuits from which transformers are excluded.

In the course of our experiments we have discovered that certain forms of audion structure are especially adapted to this end.

In particular we have been able to make audions which, without the use of transformers, provide the possibility of stepping up the input voltage, (either D.C., or any frequency

A.C.) in one step to as much as 30 times its original value, or in two successive steps to as much as 500 times its original value. The voltage amplification thus secured is entirely free from distortion whatever the initial frequency or wave form.

We have also succeeded in making audions which step down the input voltage to one-third its original value. It is not because of this property that this letter type is of value, however, but rather because its output impedance can be made as low as 500 ohms, and hence it can be worked efficiently into a line of like impedance.

These two types* of audions I shall call for convenience the "A" and "B" types, it being remembered that the "A" type effects a step-up transformation of voltage, while the "B" type is suitable for direct connection to a low impedance output line.

We have found that a combination of two of the "A" type in cascade working into one of the "B" type will operate from a line of 250 ohms impedance into a like line, with a resultant current of more than 50 times that which would flow in the second circuit if it were direct connected to the first circuit.

The importance of this for submarine cable circuits can hardly be over-emphasized, and the control of this apparatus for this purpose in countries where cables terminate should place the owners in a unique position.

It must be admitted that the "B" type audion is not an essential to this scheme of operation. We may replace one of the "B" type by from 10 to 100 of the "A" type in parallel, and secure comparable results. It is obvious, however, that the use of one audion of the "B" type is to be preferred. It is,

*A brief description of the A and B types will be found on the enclosed sheet and Figure 1

however, necessary that audions of the "A" type be used at the input end, since only this type has the property of voltage step-up transformation.

An essential part of the system of amplification is the circuit whereby the several elements are interconnected without the use of transformers. The figures will make clear the methods which we have used.

As a structural feature it should be noted that it is possible to combine in one bulb, and with a common filament, the "A" type and the "B" type audion, so that the resulting bulb allows of direct operation, with amplification, between lines of low impedance without transformers.

With reference to the use of this scheme for the amplification of telephonic currents, we have found that remarkably perfect reproduction can be obtained, and while if but a single amplification is needed transformers are successfully employed, if there is a call for successive amplifications, and especially if a loud speaking receiver is at the terminal of the line, improved results are obtained with the present scheme.

There is an additional interesting feature which should be mentioned. The input impedance of the audions as we are using them exceeds 10,000,000 ohms. It is obvious that inserting one of these in shunt across a line produces no effect on its apparent impedance. Indeed one can draw from a line of 1000 ohms impedance sufficient energy to operate a very large number of such audions in parallel without appreciably affecting the impedance of the line. This desirable result can hardly be

accomplished where transformers are used operating from the line into the audion.

A similar condition exists at any point where we are passing without transformers from one audion to the next. As many audions (possibly not exceeding 100) as desired may be multiplied off from any one, without in any way affecting the operation of the others.

As to the uses of this system other than to operate at higher speeds siphon recorders on cable lines, and for circuits where especially pure reproduction of speech or music is desired, I might mention the possibility of replacing the siphon recorder by a cheaper and more robust instrument; the possibility of direct repetition from cable to land telegraph lines; the possibility of the operation of various selecting, printing and recording devices, etc., etc.

The device is at present in operating condition to give a current amplification of 55 times between circuits of 250 ohms impedance, with sufficient energy capacity to deliver at least one-tenth of an ampere at its terminals. An entirely simple modification will allow the amplification to be enormously increased, and while we have not yet constructed a device capable of delivering more than a quarter of an ampere through 500 ohms, to do so is only a mechanical matter. We are sure that a current of one ampere could be handled without difficulty, and are hoping that even larger outputs can be provided for.

The appended figures, together with their descriptions, show circuit arrangements which we have found useful, of which

Figure 2 shows a plurality of "A" type in cascade working into a plurality of "A" type in multiple, the output going to a common circuit.

Figure 3 shows the same result secured in a simplified circuit.

Figure 4 shows a plurality of "A" type in cascade working into one of the "B" type

Figure 5 shows the same result secured in a simplified circuit.

Figure 6 shows a further circuit modification of the set of the previous figure.

Figure 7 shows a plurality of "A" type in cascade working into a plurality of "B" type in multiple; each of the "B" type feeding into a separate output circuit.

Figure 8 shows a circuit arrangement for an "A" and a "B" type combined in one bulb, with a common filament.

CONCLUSION

From the scientific and the engineering points of view we have made important progress in the following several respects:

1. We have discovered the fundamental factors and their relative importance in audion structure to such an extent that we are able to make one particular type of structure which provides a large amplification of input voltage, and another type of structure which provides large amplification of current with considerable diminution of voltage.

2. We have designed circuit arrangements such that a combination of audions can operate without the use of transformers, and even between circuits of low impedance, can give an output current in excess of 50 times the arriving current for all frequencies from those suitable to wireless signaling down to the lowest frequencies used in cable telegraphy.

We consider that this advance in the art is of momentous importance certainly in the field of cable telegraphy and probably in the allied fields of land telegraphy, and wireless telegraphy, especially with reference to recording, high speed working, and direct repetition from one type of system to any of the others.

If there is held to be anything novel in the system we believe especial care should be taken to protect its use in those countries where long distance signals are likely to terminate, be repeated, or be transferred from one of the systems (cable, land, wireless) to another.

As for telephone and allied uses, we have found in our brief experience with it some marked advantages, especially in the loud reproduction of speech and of music.

H. D. ARNOLD
EI

Enc.

FIGURE 1

A AND B STRUCTURES

In type A the grid, preferably appearing on both sides of the filament, is made of very fine mesh of very fine wire, and the plate is placed at a considerable distance from the filament. The filament need not present a large active area. The three things fundamental to successful voltage transformation are:

1. Grid must be near filament.
2. Plate must be distant from filament.
3. Grid must present a finely meshed surface between filament and plate.

In type B the grid, which may be a single wire, may be on any side of the filament, but preferably makes with the filament a plane parallel to the plate. The plate is placed as near to the filament as is conveniently possible. The filament is preferably in the form of several linear strips, each with its appropriate grid wire, and must present a large active area. The four things essential to successful amplification in a circuit of low impedance are:

1. Grid must be near filament.
2. Plate must be near filament.
3. Grid must present the least possible obstruction between filament and plate.
4. Filament area must be large.

FIGURE 2

In this circuit two A type in tandem are shown working into three A type in parallel. The batteries V_3 are adjusted to the proper values to make each grid about five volts negative with respect to its adjacent filament.

The filaments are heated by means of the batteries V_1, and the plate circuits are supplied with current from the batteries V_2.

The input voltage on the first grid causes a change in the current flowing to the plate through the high resistance R. This develops a voltage change on the grid next in series, and so on. For successful operation the resistances R should be of the order of 100,000 ohms or more.

The three final audions are shown working into a common output line. This presents to the output line an impedance equal to the value R divided by the number of multiplied audions. Hence for the most successful operation into a line of 500 ohms impedance we would require a large number of audions in parallel.

FIGURE 3

This circuit effects the same result as the circuit of Figure 2, but in a simplified manner. A common filament battery, and a common plate battery serves for all the audions. The batteries V_4 are introduced to compensate for the voltage drop through the filament.

FIGURE 4

In this circuit two A type audions in tandem are shown working into a B type audion. The operation is in all

other respects similar to that of Figure 2. It presents as an advantage over the circuit of Figure 2 the use of one audion properly designed in place of the large number of ordinary audions used in Figure 2.

FIGURE 5

This shows the same results obtained in the circuit of Figure 4, except that the audions are operated from common filament and plate batteries.

FIGURE 6

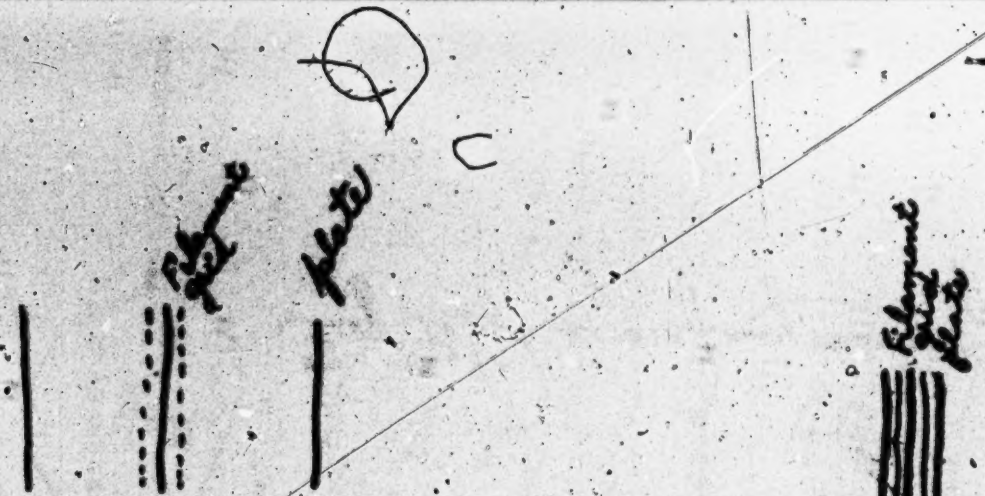
This shows a further simplification of the preceding circuits in that the various V_3 batteries may be largely reduced in voltage. This circuit is particularly applicable to telephone rather than to telegraph working.

FIGURE 7

This shows two A type audions in tandem working into a number of B type audions. It differs from the previous figures in that each B type audion is shown working into its own output circuit. This is particularly applicable to the operation of several telephone circuits or loud speaking receivers from a common talking circuit.

FIGURE 8

This shows a structure and circuit in which one bulb contains the entire necessary audion structure. The bulb contains an A type structure and a B type structure, operating from a common filament. The structure has been found to operate successfully between lines of the impedance of ordinary telephone lines without the interposition of transformers.



Type A:
Grid a fine mesh of fine wire
Plate distant from filament



Type B
Grid a single wire or
very coarse mesh
Plate near filament

E.S. 16004

Fig 1 (To accompany memo NDA-EHS 4/24/14)
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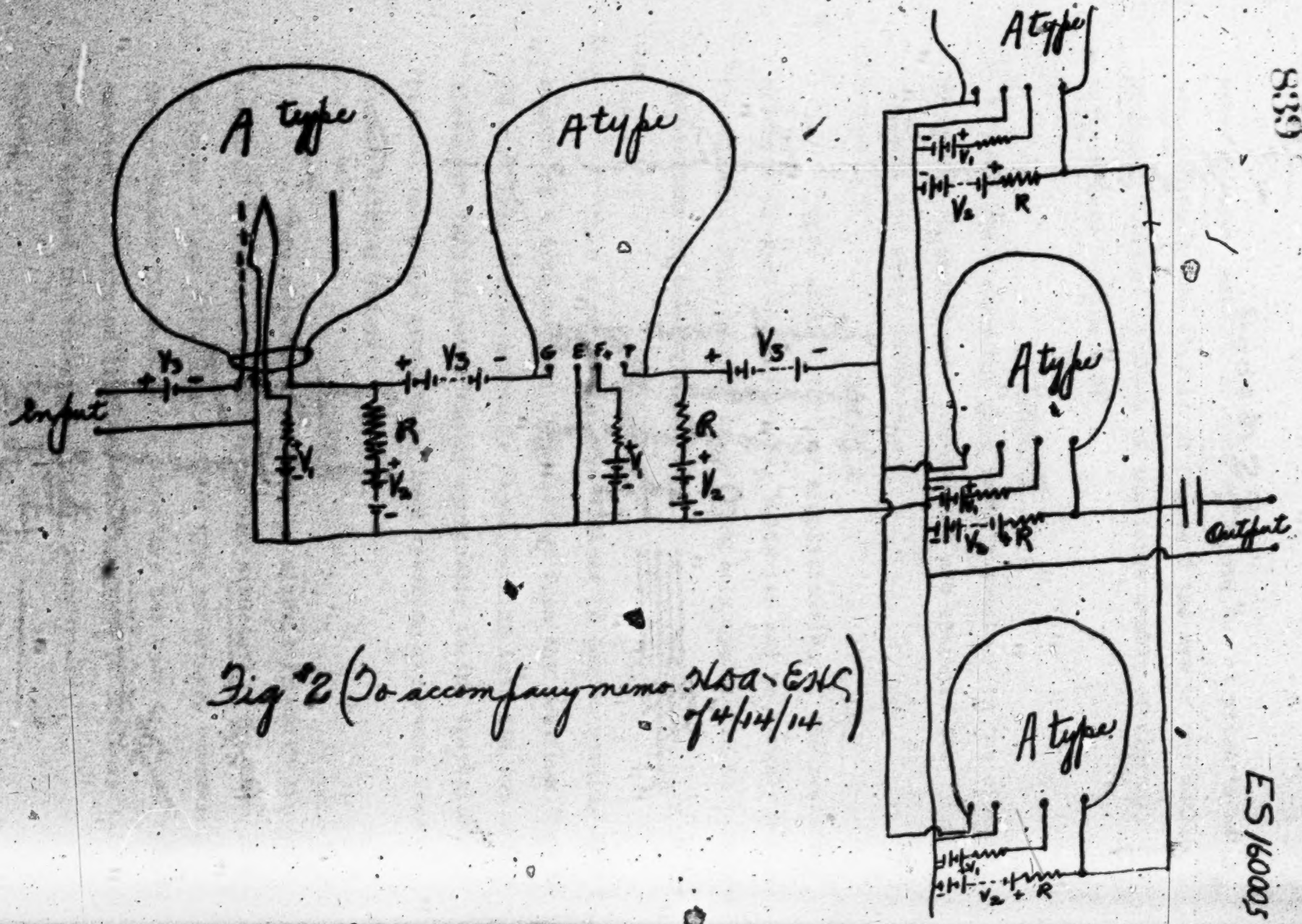


Fig #2 (To accompany memo Noa-ESH of 4/14/14)

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ES 160005

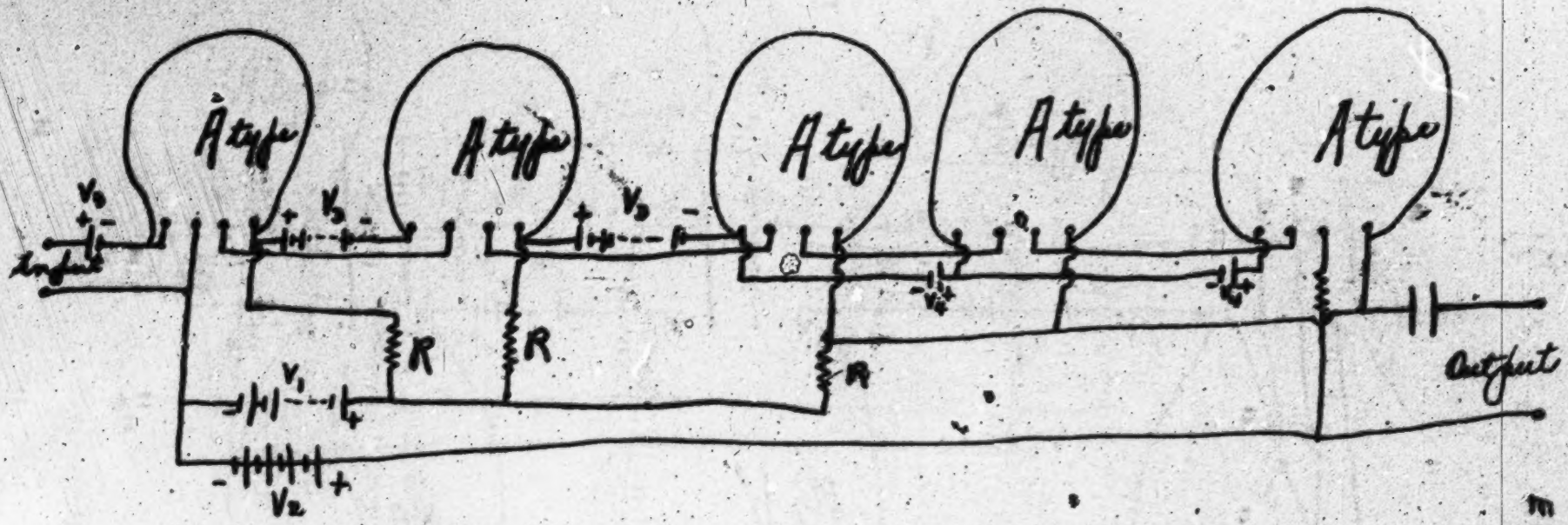


Fig # 3 (To accompany memo HDA – ESL of 4/14/14)

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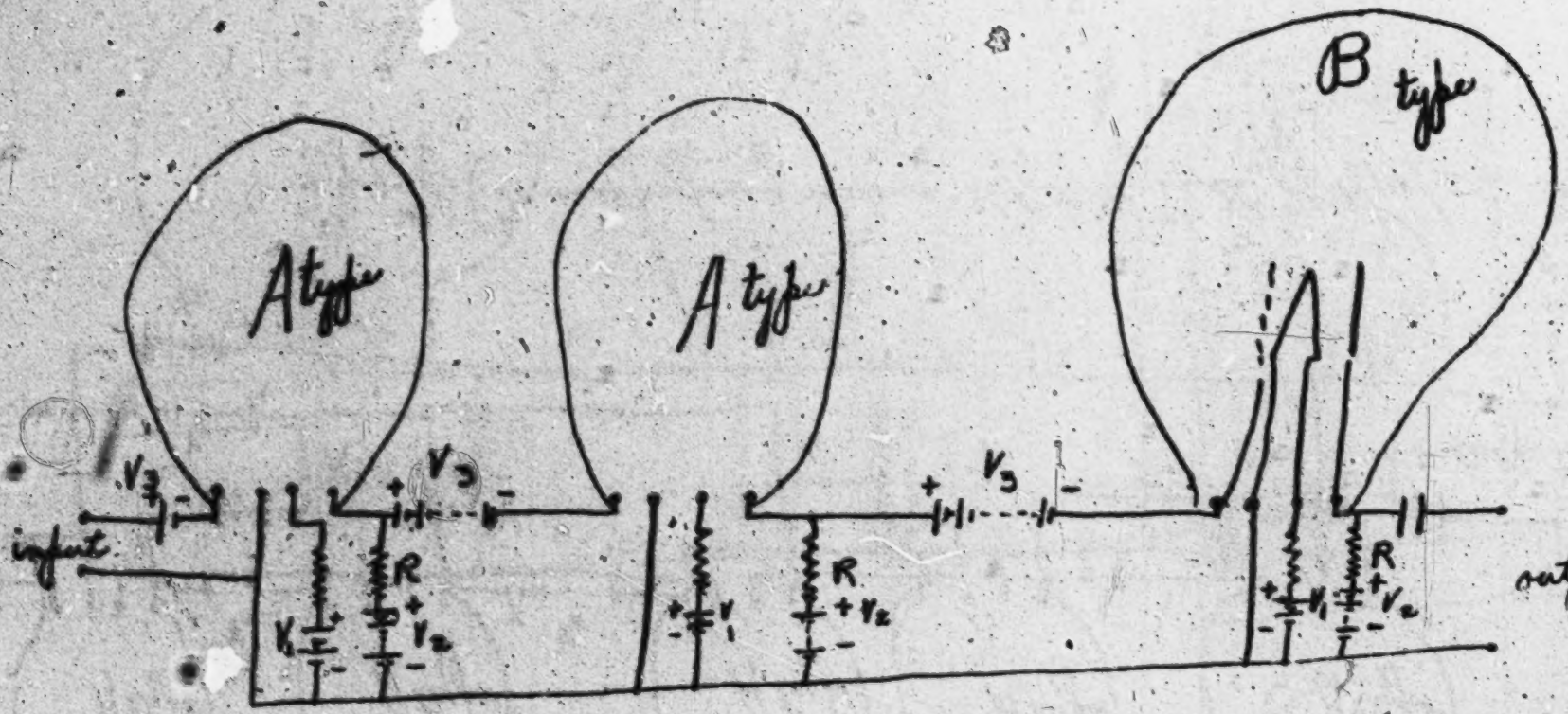
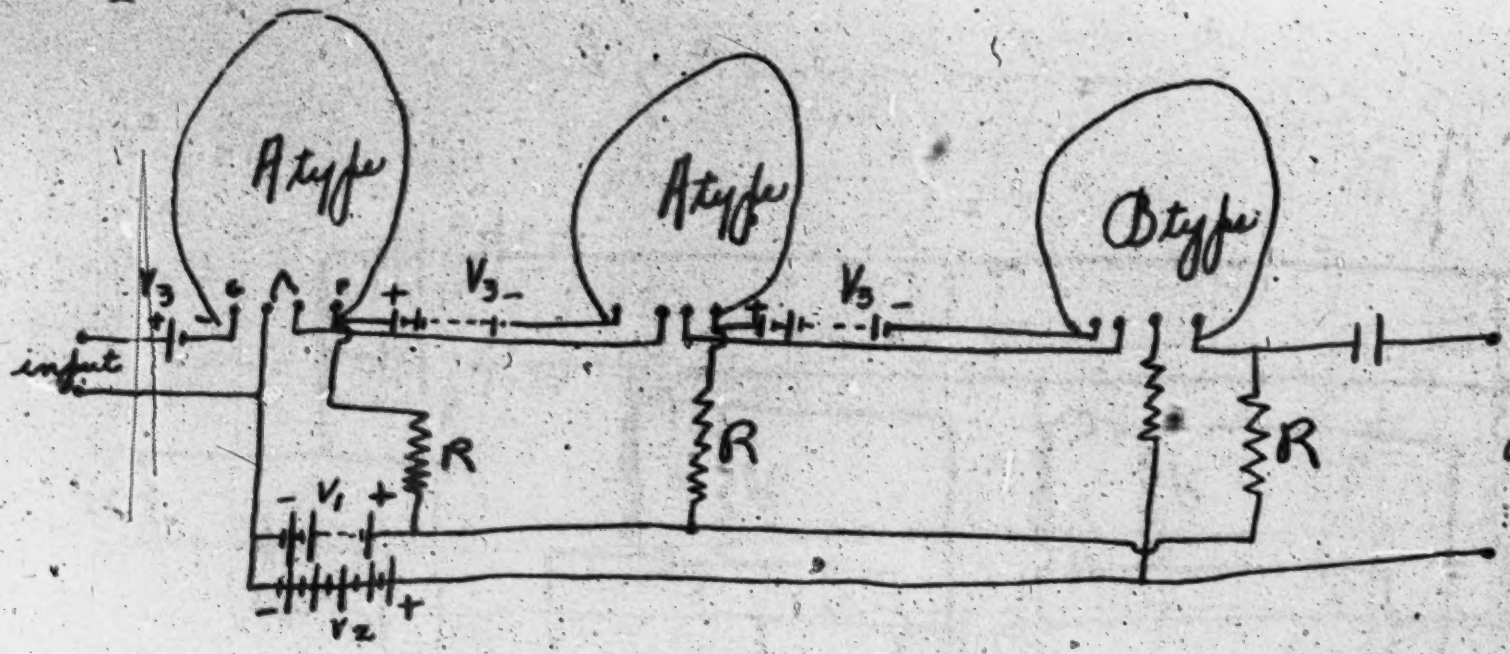


Fig 4 (To accompany memo HDA-ESK of 4/14/14)



Dig# 5 (To accompany memo 1404 - ESL of 4/14/44)

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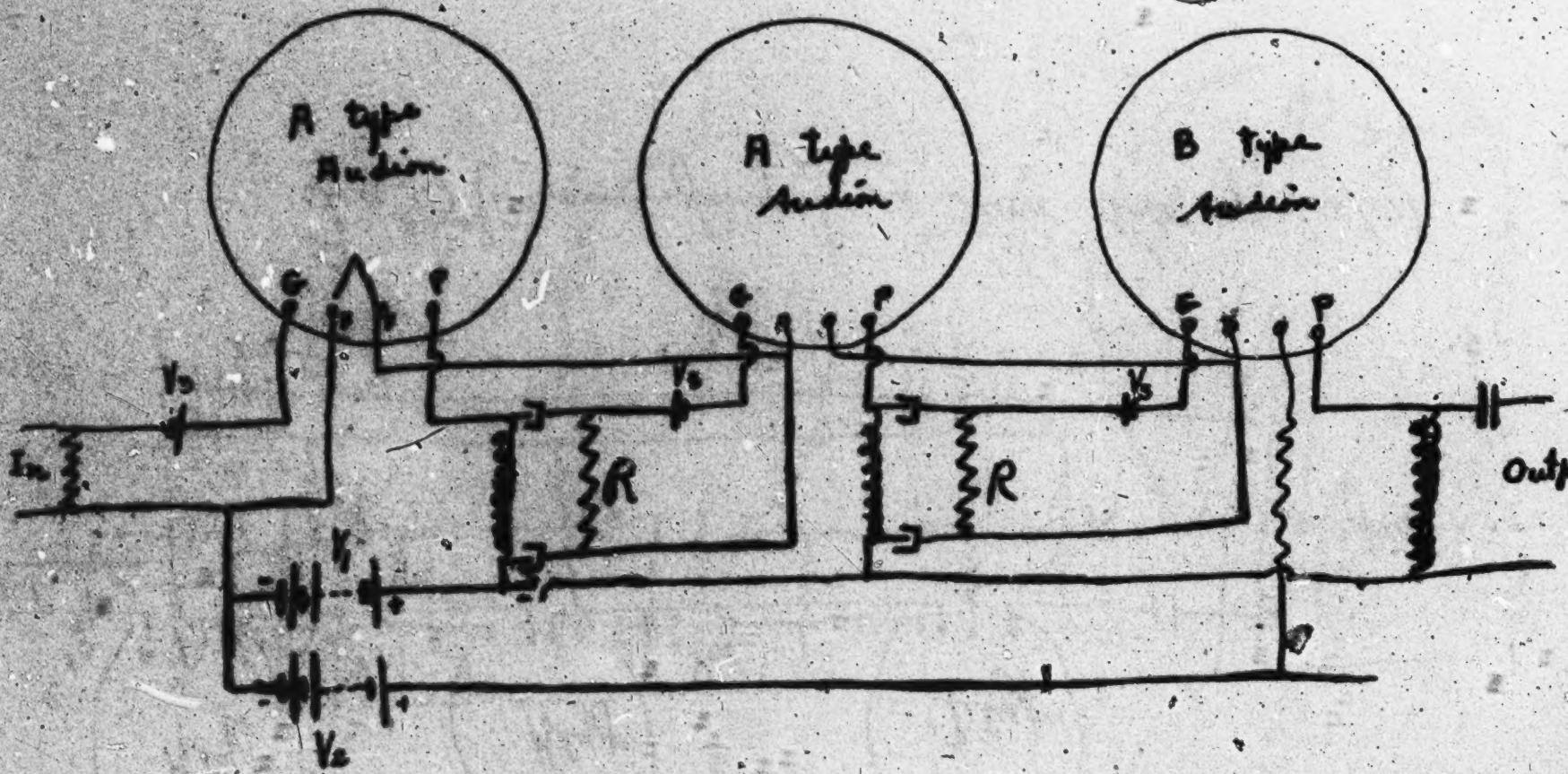


Fig 6 (To accompany memo 3604 - EOK 4/14/14)
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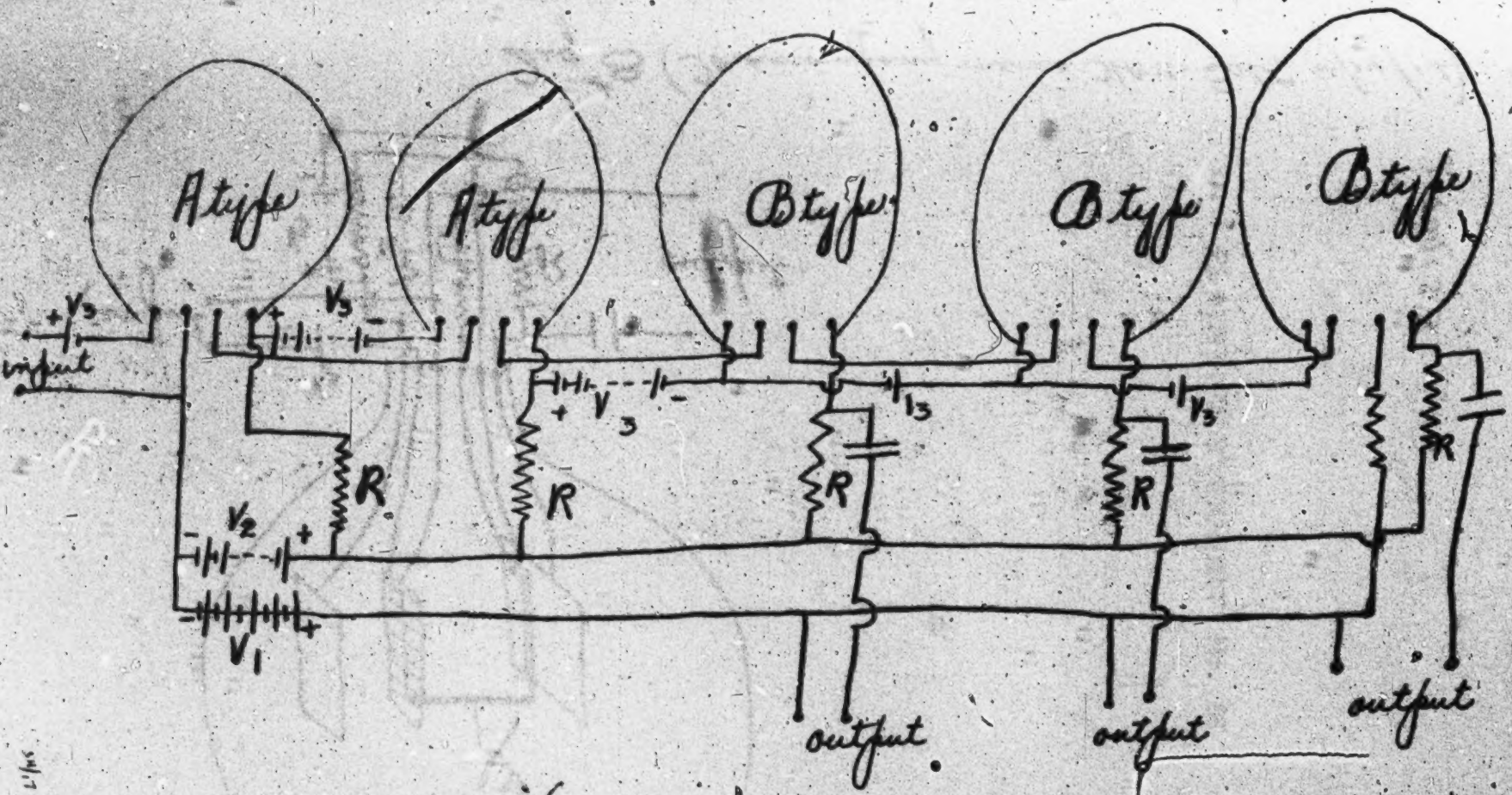


Fig #7 (To accompany memo No. a - ESL 5 of 4/14/14)

ES 160010

814

ES160011

Fig. 8 (Схемы для типа 2К2М, Есть ли/ли/ли)

PLAINTIFF S' EXHIBIT No. 55

May 9, 1933. R. T. CLOUD 1,907,741

ELECTRIC AMPLIFIER

Filed June 9, 1930

Fig. 1.

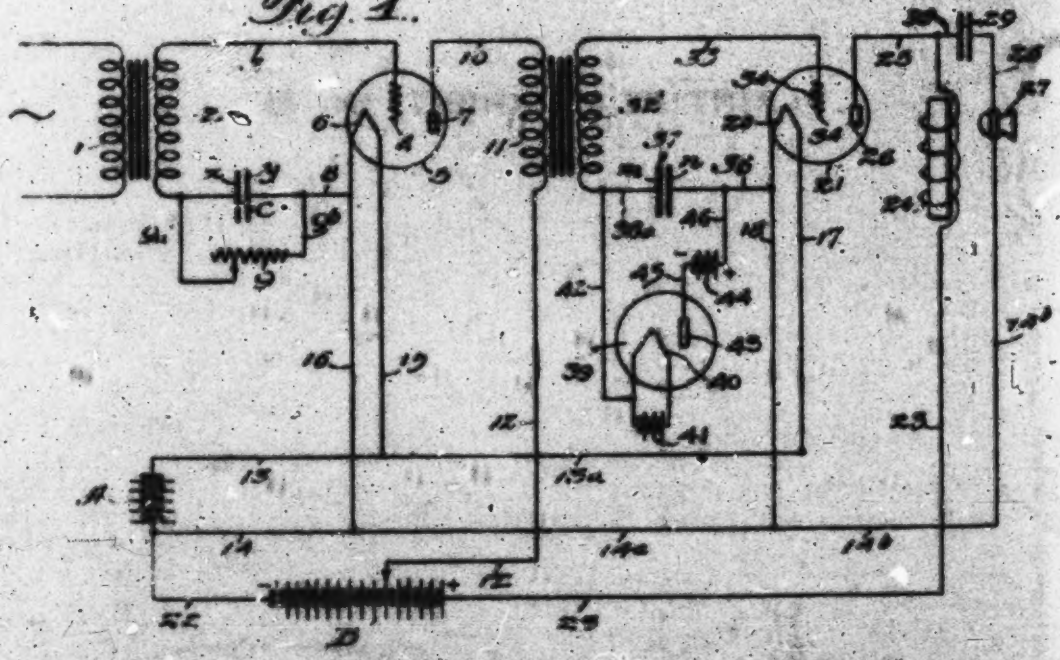
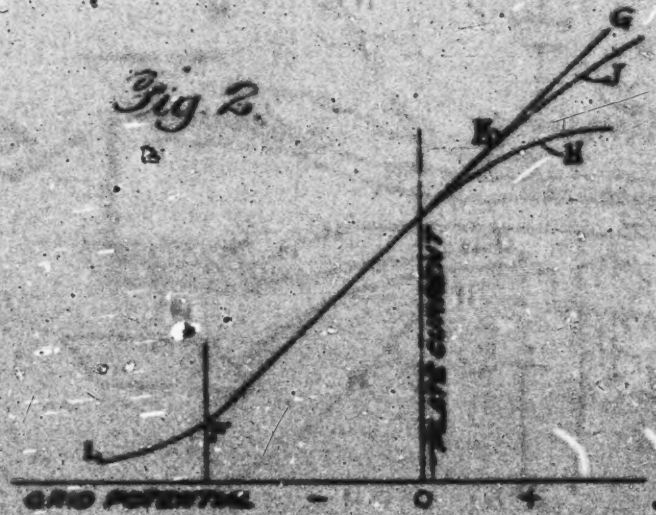


Fig 2.



Inventor
Raymond T. Cloud
By Fowler Jackson
Atty

Patented May 9, 1933 1,907,741

UNITED STATES PATENT OFFICE

RAYMOND T. CLOUD, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO EMANUEL M. ZEIONT, OF NEW YORK, N. Y.

ELECTRIC AMPLIFIER

Application filed June 8, 1928. Serial No. 283,253.

This invention relates to systems for amplifying electric currents.

The chief object is to provide an audio-frequency amplifier of high efficiency. This includes freedom from substantial distortion and the requisite volume in the sound output. More specific objects are simplicity, the use of relatively low battery or other power voltages, a greater range of signal voltage excursions, including substantially wide excursions into the positive field, with means for shifting the operating point of the signal excursions to keep the range of these excursions within the relatively non-distortive field, together with other advantages as will more fully hereinafter appear or as will be readily appreciated by those skilled in the art.

In the drawing Figure 1 represents, in the usual diagrammatic way, two stages of amplification, each of which is according to the present invention. The circuit for the first stage shown will be used preferably in the earlier stages while that of the second stage illustrated will be preferred for the last stage or the later stages in amplifiers having say three stages or more; and

Fig. 2 is a chart or graph representing voltage and current characteristics of a three-element amplifying tube.

The wiring diagram of Fig. 1 shows an audio-frequency transformer input primary 1 having an alternating signal current impressed thereon. One pole of its secondary 2 is connected by conductor 3 to the grid or control element 4 of the thermionic device or triode 5 which contains also the filament or electron-emitting cathode 6 and the plate or output terminal 7. The other pole of secondary 2 is electrically connected to filament 6 by means including the grid return conductor 8 in series with an electrostatic condenser C having plates *x* and *y*, this condenser being bridged or shunted by a resistance 9 and its connections 9*a* and 9*b*.

The plate 7 is connected by conductor 10 to the output transformer primary 11 which is connected by conductor 12 to battery B at a point providing the desired voltage for the plate.

Battery A is connected by conductors 13 and 14 to the leads 15 and 16 respectively connected to filament 6, and the same battery conductors at 13*a* and 14*a* are shown as leading to conductors 17 and 18 respectively connected with filament 20 in the second stage tube or triode 21.

Battery B is connected at one end through conductor 22 to battery A or conductor 14, and at its other end through conductor 23 to choke coil 24 in communication through the conductor 25 to plate 26 of the second stage tube. Conductor 14*b* is connected to conductor 14*a* and leads to one terminal of loud-speaker 27 while conductor 28, condenser 29 and conductor 30 connect the other pole of the loud speaker with plate conductor 25.

The second-stage input transformer secondary 32 has one pole connected through conductor 33 to grid 34 of second-stage tube 21. A condenser 37 having plates *m* and *n* is in the grid return including conductor 36, and shunting this condenser 37 is a two-element valve device consisting of the filament 40 heated by battery 41 and connected through conductor 42 to the conductor marked 36*a* on one side of the condenser 37, being the side having plate *m*, this valve device comprising also a plate 43, the battery 44 having its negative side connected through conductor 45 to the plate 43 and having its positive side connected through conductor 46 to that part of the grid return marked 36 and being on the side of the condenser 37 having plate *n*.

It will be appreciated that instead of batteries a power unit may be employed to supply current for the filaments, etc. according to what is well-known in that respect.

I may point out, also, that the present invention discloses features novel in themselves in the input circuits only, so that these circuits are the only ones calling for particular description.

The theoretical characteristic curve of the well-known triode, with respect to grid potential versus plate current, contains a substantially large part which is on a substan-

tially straight line on both sides of a point indicating zero grid potential. This line is marked F—G in Fig. 2. However, when the resistance of the ordinary audio-frequency transformer secondary is introduced into the input circuit, as at the place occupied by 2 or 32, the drop of potential through that secondary causes the curve on the positive side of the chart to deviate quite markedly from the substantially straight-line form, and is sufficiently illustrated by the line marked H. This deviation is proportionate to the ohmic resistance of such secondary, and on all but substantially small positive swings of the signal voltage the deviation is to such extent that pronounced distortion results.

In all practice heretofore, so far as I know, secondaries of high ohmic resistance have been used in the input circuits of such amplifying systems, usually with means for maintaining a negative bias on the grid to prevent the voltage excursions from entering the positive side of the curve, or if so to any extent, then but slightly.

One feature of the present invention is in the provision of a transformer secondary, as 2 or 32, of low ohmic resistance, while having the necessary high alternating-current impedance for a suitable input to such a thermionic device as a three-element tube. Owing to the relatively small potential drop through this low-ohmic secondary the excursions of the signal voltages may extend deeply into the positive side of the chart without appreciable distortion effects. The line J of Fig. 2 fairly indicates the distortion curve with a secondary of low ohmic resistance. I am thus able to utilize a much wider range of non-distortional excursions, as from F to K, than has hitherto, so far as I am aware, been found practicable.

The use of such a low resistance secondary would not alone, however, produce the desired result, primarily because on extreme excursions into the positive field the current flow on the grid circuit becomes so considerable that even the low ohmic resistance of the input secondary thus far found practicable in transformer constructions for such uses would not be sufficient to maintain the operations on that substantially straight line of the graph, as from F to K, necessary for non-distortional effects.

I therefore provide means, namely a condenser C, for limiting the positive excursions to such range thereof, as to the point K, as shown a substantially straight-like graph on the positive side of the chart.

The grid or control element as 4, when positive, attracts electrons from the cathode as 6. These negative ions accumulate on plate *a* of condenser C, building up thereon a negative potential which causes the entire sine wave of the signal to shift downward, so that the operating point of the grid potential has moved to a lower position in the negative area according to the chart. The wave is not truncated or otherwise deformed at the top, but its base is bodily shifted to another operating position. As the flow of electrons to plate *a* is proportional to the positive potential of the grid, the operating point representing the base of the sine wave of the signal is thus automatically shifted in the negative direction. This provision, then, limits the extremity of the upward or positive swing of the signal voltages.

In connection with limiting the extremities of the excursions another consideration arises. The downward shifting of the operating point might be so excessive under such conditions as where the point of operations is well downward on the negative side as to cause distortion at the lower or negative end portion of the curve, namely at the line F—L. I therefore provide means for limiting the extremity of the excursions downward in order to prevent this type of distortion. These means are shown in the first stage of amplification as a leakage path marked 9, 9a, 95 around the condenser, the element 9 being of substantially high ohmic resistance and being preferably adjustable in order readily to provide the best operating points according to the particular requirements. It will have a resistance value depending upon the amplitude of the signals, and may vary from say a million ohms to as low as say twenty-five thousand ohms. With a variable resistance constituting this leak it is a simple and easy matter to make the adjustment as required, since the function of this leak is to prevent the "blocking" of the tube on the deeply negative excursions. If blocking occurs the resistance at 9 will be decreased.

The ohmic resistance of the transformer secondary as 2 or 32 will preferably be the lowest compatible with such factors as size and weight of the transformer complete and the inherent difficulties in transformer construction with regard to distributed capacity, etc. I find a resistance of two hundred fifty ohms for such secondaries satisfactory and practical. In various embodiments this resistance will probably vary from say two hundred to five hundred ohms. Hitherto the secondaries of transformers for interstage coupling in audio-frequency transformers have ranged from about five thousand ohms to about ten thousand ohms. In this respect the invention therefore departs quite notably from prior practice.

In this connection I may point out that transformers having such low-resistance secondaries and suitable for audio-frequency amplifying circuits are not available in the

general market, and that it would be impossible to obtain the desired results, according to these improvements, with the high secondary resistances indicated as being in common use. I may suggest, too, the advisability of forming these low-resistance transformers of the open net-work type, for example of the kind known as "pancake," with a view to the thereby reduced effects of distributed capacity.

As to the condensers marked C and 37, their capacity is not critical, so far as operation is concerned, although the value of this capacity has an effect upon the quality of the reproduction with respect to the proper balance between high and low frequencies. No specific value can be given for this capacity without knowledge of the frequency characteristics of the transformer used in a given embodiment, but in any event the selection of the most advantageous capacity value is merely a matter of ordinary engineering, once the principle is given. I have successfully employed condensers in these locations of from one-fourth of a microfarad to four microfarads.

With this further understanding of the system, it may be pointed out with respect to the condenser as C that since the electrons accumulating on plate *x* counteract the tendency of the positive excursions to extend too far, the device is self-adjusting to a suitable operating point for the grid potential; and such adjustment takes place only when the same is needed, and to the necessary extent. This counteracting influence by the accumulated electrons occurs only on the positive swing, and it occurs automatically. Its effect is to move the point of operation or base of the signal sine wave farther into the negative field, and this occurs concurrently with a swing of the grid potential into the positive field. A signal of high amplitude may tend to throw the grid potential quite deeply into the positive field, but the excursion thereinto may go only a limited distance, although to a considerably greater distance than has heretofore been found feasible.

During operations the operating point of the up-and-down excursions is constantly changing, while remaining in the negative area. The negative countervailing potential varies with the signal and is effective wherever the operating point may be. The more rapid the accumulation of negative ions on condenser plate *x* the more rapid will be the downward movement of the operating point. This has the effect of preventing any positive excursion from going beyond the point where appreciable distortion would begin, as at K in Fig. 2.

I have here, also, the application of negative ions to counteract the tendency of the grid or control element to become unduly positive. In other words, the control of the positive swing is by means of free ions as distinguished from some other kind of potential.

With respect to the leakage through the ohmic resistance 9 which is adapted to limit the downward swing, while leakage at this element is taking place at all times the device is in operation with a signal impressed on the grid, such leakage is more rapid (owing to the then higher potential) when the accumulation of ions on the condenser plate *x* is relatively great. Such accumulation, as stated, moves the operating point to a lower position, but the ensuing rapid leakage tends to move the point of operation upward. The effect is that the operating point is moved downward until a balance of these opposing influences is reached, that point depending upon the amplitude of the signal at the time. The point of operation may move quite suddenly downward, but it will stop in this downward course far above the point F of Fig. 2, and this results from the adjustment of leak 9 which provides for such a rapid discharge under accumulated potential on plate *x* as to hold the point of operation from moving too low.

This condenser and leak device is thus a regulator or control for both the positive and the negative excursions. As a unit it prevents these excursions from extending into the respective fields to apposition where material or substantial distortion of the signal would occur.

The low ohmic resistance of the secondary as 2 extends the available range on the positive side. I have thus, according to this system, an unusually wide range for the substantially non-distortional effects desired.

Turning to the second stage in Fig. 1, the input circuit may be considered the same as in the first stage except for the valve 39, which, as illustrated, but without limitation, is a two-electrode tube known as a Fleming valve. It has a filament 40 and plate 43. I provide also a direct current negative voltage for the plate shown as a battery 44. In the later stages of amplification the signal amplitudes are relatively great. Such signals can be amplified properly according to the first stage, but in view of the larger amounts of power current involved in the later stages, with correspondingly greater fluctuations thereof, I consider it more satisfactory to withhold leakage of the electronic charge on plate *m* of condenser 37 until it has reached some predetermined negative potential beyond which distortion on the negative side is likely to occur. This value is determined by battery 44, the negative terminal of which is connected to anode 43 of the unidirectional current device of which it forms a part.

Let us assume a negative potential of ten

850

volts impressed by battery 44 on anode or plate 43. As is well known, no current will flow from battery 44 across the space between anode 43 and cathode 40. In such a device there is no current flow unless the anode 43 is positive to cathode 40. Now, when the negative charge on condenser plate 37 exceeds the ten volts negative impressed on the anode the anode becomes positive to the cathode and an ionic discharge between cathode 40 and anode 43 takes place.

The valve device just described is a modified form of leak operating similarly to leak 39 but becoming effective only when the condenser charge exceeds a predetermined value.

The blocking battery 44 has no function or effect other than to determine the limit of accumulated potential on condenser 37. Its voltage never reaches the grid 34 or filament 33, and no current from battery 44 flows at any time through triode 21 or between any of its elements. In short, battery 44 has no current flow.

As in the first stage, this condenser and leak 37—39 is a device which controls both the positive and negative excursions of the grid potential and limits the extremities thereof to the substantially non-distortional range.

The voltages of battery B will vary for different stages, according to the tubes employed, etc., but will ordinarily be from twenty-five percent to fifty percent less than those usually employed in other types of amplifiers.

I contemplate as being included in the present invention all such changes, variations and departures from what is specifically illustrated and described herein as fall within the scope of the appended claims.

I claim:

1. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transfer secondary of materially low ohmic resistance included in said circuit, and means in series with one of said triode elements and said secondary for limiting the extremities of positive excursions of the control element potential.

2. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transformer secondary of materially low ohmic resistance included in said circuit, and means in series with one of said triode elements and said secondary for limiting the extremities of positive and negative excursions of the control element potential.

3. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transformer secondary having a resistance of less than one thousand ohms included in said circuit, and means in series with one of said triode elements and said secondary for limiting the positive excursions of the control element potential.

4. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transformer secondary having a resistance of less than five hundred ohms included in said circuit, and means in series with one of said triode elements and said secondary for limiting the positive excursions of the control element potential.

5. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transformer secondary having a resistance of less than three hundred ohms included in said circuit, and means in series with one of said triode elements and said secondary for limiting the positive excursions of the control element potential.

6. In an amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transformer secondary having a resistance of less than one thousand ohms included in said circuit, and means in series with one of said triode elements and said secondary for limiting the extremities of the positive and negative excursions of control element potential.

7. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode and input transformer secondary included in said circuit, said secondary having an ohmic resistance so low as to provide for a materially great range of substantially non-distortional positive excursions of the control element potential, and means for limiting such positive excursions substantially to such substantially non-distortional range.

8. In an audio-frequency amplifier, an input circuit including the electron-emitting cathode and the control element of a thermionic triode, an input transformer secondary included in said circuit and being of materially low ohmic resistance to provide a materially great range of substantially non-distortional positive excursions of the control-element potential, said circuit including means forming a path for signal voltages from one pole of the transformer secondary to said control element and means

forming another path for such voltages from the other pole of said secondary to said cathode, one of said paths including an electrostatic condenser and a leak in shunt with said condenser.

9. In an audio-frequency amplifier, an input signal-amplifying circuit which includes a thermionic device having an electron-emitting element, a control element and an output element, and means in said circuit including an input transformer secondary of materially low ohmic resistance for providing a materially great substantially non-distortional range of positive excursions of the control element potential.

10. In an audio-frequency amplifier, an input signal-amplifying circuit which includes a thermionic device having a control element and an electron-emitting element, means external to the thermionic device and in said circuit for providing a substantially great range of positive excursions of the control element potential, and means for automatically limiting such positive excursions to substantially a non-distortional range.

11. In an audio-frequency amplifier, an input signal-amplifying circuit which includes a thermionic device having an electron-emitting element, a control element and an output element, said circuit including also an input transformer secondary of materially low ohmic resistance, and means for automatically shifting positively the point of operation of said control element potential during negative excursions respectively.

12. In an audio-frequency amplifier, an input signal-amplifying circuit which includes a thermionic device having an electron-emitting element, a control element and an output element, said circuit including also an input transformer secondary of materially low ohmic resistance, and means for alternately shifting in the positive and negative directions the point of operation of excursions of the control element potential to maintain the limits of the negative and positive excursions respectively within a substantially non-distortional range.

13. In an audio-frequency amplifier, an input signal-amplifying system which includes a thermionic device having an electron-emitting element, a cathode element and an output element, a transformer secondary of materially low ohmic resistance in said circuit and means for controlling an excursion of the control-element potential by shifting the point of operation of the control element potential in a direction opposite to the potential of the excursion.

14. In an audio-frequency amplifier, an input circuit which includes a thermionic device having grid, plate and cathode elements, a transformer input secondary of materially low ohmic resistance, and means for controlling the excursions of the signal potential of the grid element, said means comprising a capacity device in said circuit and a materially high resistance leak shunting said capacity device.

15. In an audio-frequency amplifier, an input signal-amplifying system employing a thermionic device having grid, plate and cathode elements, a transformer secondary of materially low ohmic resistance in said circuit, and means for controlling the excursions of the signal potential of the grid element, said means comprising a capacity device in said circuit and a unilateral current-conducting device in shunt with said capacity device together with means for automatically controlling the action of said current-conducting device.

16. In an audio-frequency amplifier, an input circuit including the control element and the electron-emitting element of a thermionic triode and including a materially low ohmic resistance source of signal oscillations, with means for controlling the excursions of the control element potential including an electrostatic condenser in series with said source and with one of said elements, a two-electrode tube serving as a one-way valve having cathode and anode and being in shunt with said condenser, and a source of direct-current potential in series with said anode and one side of said condenser, the potential of said current source serving to determine the potential at which said condenser will discharge between the cathode and the anode of said valve.

17. In an audio-frequency amplifier, an input circuit including the control element and the electron-emitting element of a thermionic triode and including a materially low ohmic resistance source of signal oscillations, with means producing a controllable ionic potential for automatically shifting the operating point of the control element potential in a direction opposite to the potential of the excursion.

18. In an audio-frequency amplifying system of the character described, an input circuit including the electron-emitting element and the control element of a thermionic triode, an input transformer secondary in said circuit and having an ohmic resistance so low as to provide for a materially great range of substantially non-distortional positive excursions of the control-element potential, with an electrostatic condenser in said circuit and between said electron-emitting element and said secondary, and a resistance leak shunting said condenser.

RAYMOND T. CLOUD.

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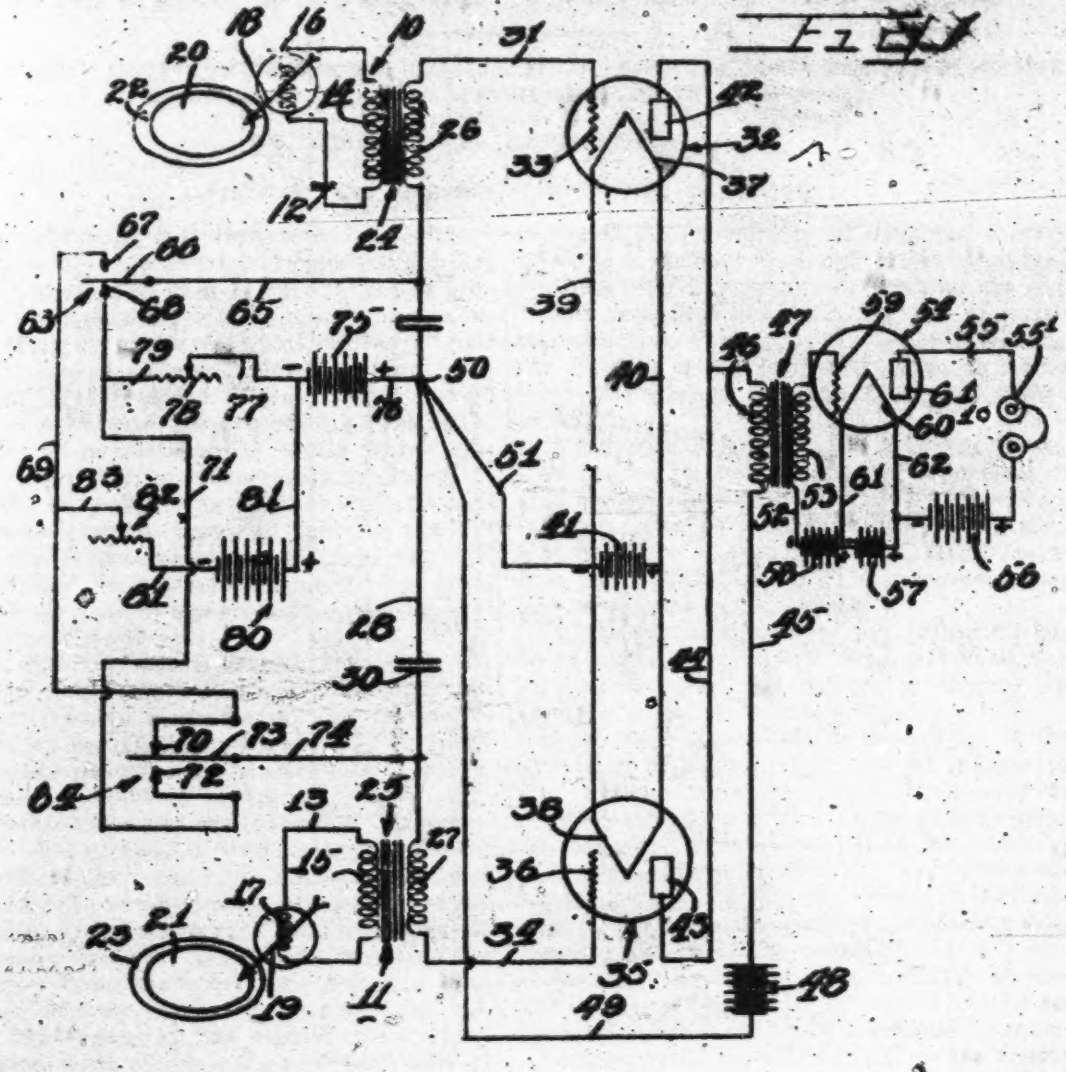
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PLAINTIFF S' EXHIBIT No. 56

June 28, 1932. R. T. CLOUD 1,864,890

ELECTRICAL REPRODUCER

Filed Nov. 19, 1927 2 Sheets-Sheet 1



INVENTOR
Raymond T. Cloud
Charles W. Hills

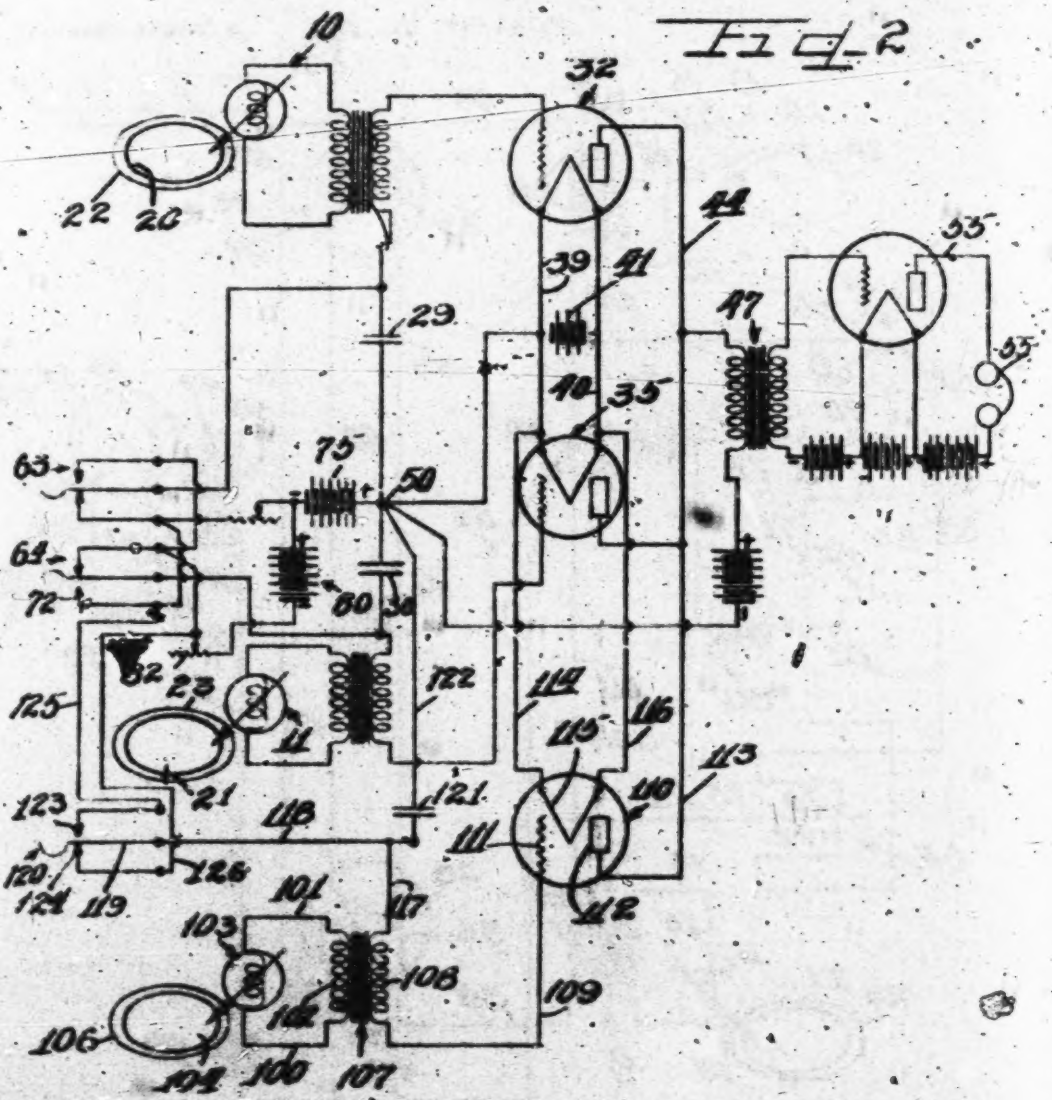
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June 26, 1932. R. T. CLOUD 1,864,890

ELECTRICAL REPRODUCER

Filed Nov. 19, 1927 2 Sheets-Sheet 2

Fig. 2



Inventor
Raymond T. Cloud
by Parker & Kell
Attys

Patented June 28, 1932 1,864,890

UNITED STATES PATENT OFFICE

RAYMOND T. CLOUD, OF CHICAGO, ILLINOIS, ASSIGNOR TO ORCHESTRAPHONE COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE

ELECTRICAL REPRODUCER

Application filed November 18, 1927. Serial No. 234,247.

My present invention pertains to electrical reproducing apparatus, and more particularly to a method of and an apparatus for contemporaneously reproducing, in a single reproducing unit, the electrical impulses from a plurality of different sources. More specifically, the invention relates to a method of and an apparatus for controlling the reproduction of music or other sound waves in a single reproducing unit from a plurality of records, in such a manner that even though the records might be at all times in contact with the respective electrical pick-ups, still music may be reproduced selectively from any one or more of the records as desired, and not from the others.

An object of my invention resides in the provision of a method of and an apparatus for electrically reproducing the waves recorded on records in such a manner that any one of the records may be alternately and selectively reproduced as desired.

Another object of my invention is the provision of a method of and an apparatus for controlling the reproduction of waves from a plurality of records in such a manner that the impulses from one record can be caused to gradually decrease in volume, whereas the impulses from the other record can be contemporaneously gradually increased in volume, thus enabling the reproduction of an electrical wave which is the resultant wave of the different sets of impulses.

Still another object of my invention has to do with the provision of a method of and an apparatus for electrically reproducing the waves recorded on a plurality of records in such a way that these records can be alternately reproduced without the detection of the change from one record to the other.

A further object of my invention is the provision of a method of and an apparatus for electrically reproducing the waves recorded on a plurality of records in such a manner that the reproduction is a resultant wave in which the components are overlapping impulses from the different records.

A still further object of my invention is the provision of a method of and an apparatus for electrically reproducing the music recorded on a plurality of different records in such a manner that the music produced consists of overlapping waves from the different records, thus enabling the alternate reproduction of each of the records without the listener being ordinarily able to detect when the change is made from one record to another.

Another and further object of my invention resides in the provision of a method of and an apparatus for controlling or delaying the action of a thermionic valve in such a manner that it does not become fully operative or inoperative until a predetermined period of time has elapsed.

A still further object of my invention has to do with the provision of a method of and an apparatus for exponentially varying the electron emission in a thermionic valve.

A further object of the invention is the provision of a method of and an apparatus for reproducing sound from a plurality of phonograph records in a single sound reproducing unit, in such a way that the intensity of the sound from each of the several records may be varied, while the intensity, of the sound emitted by the single reproducing unit remains substantially constant.

Another important object of my invention is the provision of a method of and an apparatus for electrically reproducing musical waves from records as well as the reproduction of the illusion of approaching and receding bodies so that while one record is providing the music, another may be brought into play to reproduce the whistling of a locomotive, the ringing of bells and the like.

A still further object of the invention resides in the provision of a method of and an apparatus for controlling the transfer of power from two different electrical sources, each capable of a relatively constant input, to a common receiver through two thermionic tubes in such a manner that the electronic emission in one of the tubes may be increased, while the electronic emission in the other of the tubes is being decreased and yet at the same time enable the total output of the tubes to the common receiver to remain substantially constant in volume while

one of the sources is being switched into operative association with the receiver and the other of the sources is being switched out of operative association with the receiver.

In accordance with the general features of the present invention, I provide a sound reproducer having two record turntables with a record on each, electrical pick-up means in operative association with the records, electrical sound transmitting means connected to a reproducing unit, and means including an electrical circuit for controlling the sound output of the pick-ups and for increasing the output of one pick-up while decreasing the output of the other pick-up to electrically produce sound in the reproducing unit from either record as desired.

Other objects and advantages of my invention will more fully appear from the following detailed description taken in connection with the accompanying drawings, which illustrate several embodiments thereof and in which:

Figure 1 is a diagrammatic view illustrating a novel electrical circuit embodying the features of my invention, and

Figure 2 is a diagrammatic view similar to Figure 1 illustrating the circuit as being provided with an additional input device adapted to be operated when it is desired to reproduce the illusion of an approaching or receding train or the like by the whistling of a locomotive.

It is thought that my novel method of electrically reproducing waves will be evident from a description of an apparatus by which the process may be practiced.

In the drawings:

Like reference characters designate similar parts throughout the several views.

The reference characters 10 and 11 designate generally the input devices of my novel electrical circuit. Each of these devices comprises a circuit 12—13, which includes a primary transformer winding 14—15, and a pick-up resistance 16—17. The two resistances 16 and 17 comprise parts of electrical pick-ups designated generally by the reference characters 18 and 19.

These electrical pick-ups may be of any conventional construction. These devices 18 and 19 are operatively associated with the records to be electrically reproduced. In accordance with the features of a preferred embodiment of my invention, I have illustrated their pick-ups as being operatively associated with phonograph records 20 and 21. These phonograph records are mounted on turntables 22 and 23, which may be rotated by any suitable means, such, for example, as electrical motors (not shown), as is well known in the art. Also it is to be noted that my invention permits of both of these turntables rotating contemporaneously throughout the period of time that music is being reproduced. As will be more fully explained hereinafter, when one record is being reproduced, another record may be placed on the other rotating table in a condition ready to be reproduced when the pick-up associated with the former record is rendered ineffective.

The primary windings 14 and 15 comprise parts of transformers designated generally by the reference characters 24 and 25. The secondary windings 26 and 27 of these two transformers 24 and 25 are connected by a common lead wire 28, in which is interposed a pair of fixed condensers 29 and 30, the purpose of which will be more fully described in connection with the operation of my circuit. It will also be noted that the transformer winding 26 is connected by a conductor 31 with the grid 33 of a thermionic tube 32, and that the winding 27 is connected by a conductor 34 to the grid 36 of another thermionic tube 35. The filaments 37 and 38 of the two tubes 32 and 35, respectively, are connected together by conductors 39 and 40. Connected in parallel to the conductors 39 and 40 is an A battery 41.

The plates 42 and 43 of the two tubes 32 and 35, respectivaly, are connected by means of a common lead 44. Connected to this lead 44 between its ends is one end of a conductor 45, including the primary winding 46 of an output transformer 47. The other end of the conductor 45 is connected to one side of a battery 48. The other side of the battery is connected by a conductor 49 to a point 50 in lead wire 28. It will also be noted that a conductor 51 connects this point 50 with the negative side of A battery 41.

The secondary winding 52 of output transformer 47 comprises part of an electrical reproducing or receiving circuit 53, which includes an amplifier tube 54, a head set or loud speaker 55 and A, B and C batteries 56, 57 and 58. The tube 54 is a conventional three element tube and includes a grid 59, a filament 60' and a plate 60. The filament 60' is connected by leads 61 and 62 to A battery 57.

I shall now proceed to describe in detail the control mechanism, including the switches, for controlling the electron emission in tubes 32 and 35, whereby the music reproduced in the circuit 53 may be selectively controlled. The lead 28 has connected to it, adjacent condenser 29, one end of a conductor 63, the other end of which is connected to a switch element 66 adapted to cooperate with switch points 67 and 68. The switch point 67 is connected to one end of a conductor 69, the other end of which terminates in a switch contact point 70 of another switch. The switch point 68 is connected by a conductor 71 to the switch point 72 of said other switch. These switch points 70 and 72 are adapted to cooperate with a

switch element 73 connected by a conductor 74 to circuit lead 26. I have designated generally the two switches above described by the reference characters 63 and 64.

A bias battery 75 is connected on one side by a conductor 76 to point 50, previously described, in lead 28. The other side of battery 75 is connected by a conductor 77 to a variable resistance 78, which is connected by a conductor 79 to an intermediate part of conductor 71. The conductor 77 has secured to it one end of conductor 81, which is electrically connected to one side of a C bias battery 80, which I shall hereinafter refer to as a blocking battery. The other side of this battery is connected by a conductor 81 to a variable resistance 82 connected by a conductor 83 to an intermediate point in lead 69.

From the foregoing, it will be evident that there are two C bias batteries adapted to be electrically connected to the grids 33 and 36 of tubes 32 and 35. The C battery 75 is adapted to be connected to either of these grids for the normal operation of the associated tube, whereas the C battery 80 is adapted to be connected to either of these grids for the purpose of blocking the action of the associated tube or valve. Attention is also directed to the fact that the switches 63 and 64 are adapted to be operated, as will be more fully explained hereinafter, to control the selective operation of thermionic tubes 32 and 35, so that these tubes may be alternately connected to the reproducing or receiver circuit 55.

The resistances or resistors 78 and 82 are designed to control the rate that condensers 29 and 30 are charged and discharged, so as to enable the selective control of the blocking out of the tubes 32 or 35, as well as the setting into action of these tubes.

The C bias battery 75 is intended to be of such capacity as to provide the normal amount of voltage needed to charge the grids 33 and 36 of tubes 32 and 35 without overloading or blocking them, whereas the C bias battery 80 is of such a capacity as to be capable of providing sufficient voltage to these grids as to overload them and thus prevent their normal operation.

The operation of my novel circuit is briefly as follows:

When the switches 63 and 64 are in the positions shown in Figure 1, the blocking battery 80 will be connected so as to charge condenser 30, and the normal battery 75 will be connected to the grid 33 of tube 32. It will be evident that the blocking battery 80 will charge the condenser 30 and give the grid 36 of tube 35 a charge of the proper intensity to block the emission of electrons from the filament 38 to the plate 43 of tube 35, thus rendering this tube inoperative as an amplifier or relay. Of course, it is to be understood that the rate at which the potential of grid 36 is built up depends upon the rate at which condenser 30 is charged. This rate, of course, will be controlled by the position of the resistor 82. That is to say, upon the initial connection of blocking battery 80 to condenser 30 and grid 36, the resistor 82 will serve as a means to delay the building up of the overloading potential of grid 36. In other words, the resistor 82 permits of the tube 35 being gradually rendered inoperative by the building up of the potential on grid 36 from battery 80. However, it is to be remembered that this feature would not be possible if it were not for the condenser 30, which is charged at a predetermined rate depending upon the position of resistor 82. Furthermore, I find that the rate at which the potential on grid 36 is built up may be plotted graphically, and that the resultant curve takes the form of an exponential curve.

Obviously by gradually building up the potential of grid 36, it is possible to gradually decrease the electronic emission in the tube 35 between the plate and the grid thereof. In fact, this electronic emission decreases exponentially.

In Figure 1 it will also be observed that the battery 75 is connected through switch 63 to the grid 33 of tube 32. This battery serves to supply a voltage sufficient for the normal operation of tube 32.

It will also be evident from Figure 1 that when tube 32 is operative, the waves entering the transformer 10 from the pick-up device 18 will be amplified and reproduced in the receiver or reproducing circuit 55. On the other hand, the rendering inoperative of the tube 35 will prevent any reproduction of the waves entering transformer 11 from pick-up device 19.

When the record 20 on turntable 22 has been substantially reproduced in the receiver circuit 55, or when it is desired to change from the record 20 to the record 21 on turntable 23, it will be necessary to operate switches 63 and 64, so as to move contact element 66 into cooperation with switch point 67 and contact element 73 into cooperation with switch point 72. It will, of course, be evident that the operation of these two switches 63 and 64 may be accomplished contemporaneously by the means of a suitable cam key or the like, such as is well known in the art. In any event, it is desirable to operate these two switches at the same time, and hence the switch arms or elements 66 and 73 should be mechanically connected together.

This operation of the switches 63 and 64 will result in the blocking battery 80 being connected to condenser 29 and grid 33 of tube or valve 32, and the normal battery 75 being connected to grid 36 of tube or valve 35. Also it will be evident that the condenser 30 will no longer be charged by the overload

battery 80 and hence will begin to discharge through the resistor 78. The rate at which this condenser discharges can be controlled exponentially by the resistor 78. Obviously by gradually causing the condenser 29 to discharge, the overload potential on grid 26 will gradually decrease, thus allowing the tube 25 to be gradually brought into operation. When the condenser 29 has become discharged to such an extent that the grid 26 has a normal potential, the normal battery 75 will function to maintain this normal potential in this grid.

By connecting the overload C bias battery 80 to the condenser 29, the potential on grid 33 of tube 32 will be gradually increased, thus causing the amplifying action of this tube to be proportionately diminished. In other words, the electronic emission in the tube 32 can be gradually decreased, thus decreasing the intensity of the waves reaching the receiving circuit 55 from the pick-up 18. When the condenser 29 has become fully charged by the blocking battery 80, the tube 32 will have been rendered completely inoperative.

From the foregoing, it will be evident that one tube can be gradually brought into operation, and the other tube can be gradually rendered inoperative. This means that the electrical waves reaching the circuit 55 from one pick-up will gradually decrease in intensity, while the electrical waves from the other pick-up will gradually increase in intensity. The wave reproduced in the loud speaker or head set 55' will be a resultant of these two sets of varying waves or impulses. Thus, it will be evident that when one record is brought into play, the music reproduced therefrom will overlap the impulses coming from the tube which is gradually being blocked by battery 80. This overlapping feature is desirable for the reason that it prevents the listener from being ordinarily able to detect when the change is made from one record to another. That is to say, the records 20 and 21 can be alternately reproduced in the receiving circuit 55 without the detection of the change from one record to the other. As previously pointed out, at the time this change is made the music emanating from the head set 55' will comprise a resultant wave, in which the components are the overlapping impulses from the two amplifying tubes 32 and 35.

It is evident from the foregoing, that as soon as a record has been blocked out so that reproduction from this record has ceased, the pick-up may be removed from contact with that record and another record may be substituted for it, and the pick-up may be placed in contact with the substituted record. Each of the pick-ups is so arranged that it may be removed from contact with the associated record at any time and moreover this may be accomplished either manually or automatically as desired by the operator.

The records 20 and 21 are illustrated as being of the ordinary disc type, which may be rotated with the turntables 22 and 23 by any suitable means such, for example, as the conventional electric motor. It is, of course, apparent that the present invention is not to be limited in its application to the use of such disc records, for obviously the invention may be employed in connection with cylinder records or to any records upon which sound waves or other waves to be reproduced have been recorded, irrespective of the manner in which these waves are recorded. As previously pointed out, the pick-ups 18 and 19 may be of any suitable type adapted to receive the recorded impulse and to transform it into an electrical impulse.

In Figure 2 I have illustrated a modification of my invention, wherein an additional input device 100 is connected so as to modulate the electrical current flowing in the amplifying circuit. Inasmuch as the circuit associated with the other two input units shown in Figure 2 operates in identically the same way as that shown in Figure 1, the same reference characters will be applied to the elements comprising this circuit as were used in connection with Figure 1. Different reference characters will be applied to the parts of the circuit shown in Figure 2 used to couple the third input device 100 to the other circuit. The input device 100 comprises a circuit 101 including a primary transformer winding 102 and a resistance 103 comprising part of an electrical pick-up device 104. The pick-up device is operatively associated with a disc record 105 of the phonograph type disposed on a rotatable turntable 106.

The winding 102 constitutes part of a transformer 107, which also includes a secondary winding 108. One end of this winding 108 is connected by a conductor 109 to the grid 111 of an amplifying tube or valve 110. The plate 112 of this tube is connected by a conductor 113 to conductor 44 connected to the plates of the other two tubes 32 and 35. The filament 115 of this tube is connected by conductors 114 and 116 to the leads 39 and 40 connecting the filaments of the tubes 32 and 35. In other words, the filament 115 is so connected as to receive current from the A battery 41 common to filaments of tubes 32 and 35.

The other end of transformer 108 is connected by a short length of wire 117 to a conductor 118. One end of this conductor 118 is secured to a switch element or arm 119 of a switch 120. The other end of this wire 118 is connected to a fixed condenser 121 which is connected by wire 122 to point 50 of the main circuit.

The switch 120 includes a pair of oppositely disposed contacts 123 and 124 cooperable with

switch element 119. One of these contacts 123 is connected by a conductor 125 to switch contact 72 of switch 64. The other switch contact 124 is connected by a conductor 126 to resistor 82.

The operation of this additional input device 100 and the associated amplifying tube 110 is briefly as follows:

The switch element or arm 119 is shown in a position (Figure 2) wherein it is in engagement with contact 124 and hence results in the grid 111 of tube 110 being connected to the overload C battery 80 through the resistor 82. This means that the grid 111 is provided such a high potential that the action of tube 110 is blocked. When it is desired to render the tube 110 operative so as to enable the reproduction of the music on record 105 in the receiving circuit 55, the same may be accomplished by moving switch element 119 out of cooperation with contact 124 and into engagement with contact 123. This will result in the grid 111 being disconnected from the blocking battery 80 and being connected to the normal C bias battery 78. Of course, it is to be understood that the minute switch arm 119 has moved out of cooperation with contact 124, the condenser 121 will begin to discharge. As the condenser 121 discharges, the potential on grid 111 is gradually decreased, thus resulting in the tube 110 gradually becoming operative. In fact, the rate of the electronic discharge in the tube between the plate 112 and the filament 115 will follow substantially an exponential curve. After the condenser 121 has discharged to a sufficient extent to cause grid 111 to have a normal potential, the tube 110 will become fully operative.

Thereafter, when it is desired to render the tube 110 inoperative, the same may be accomplished by moving switch arm 119 back into engagement with contact 124 of switch 120. This will mean that the blocking battery 80 will being to gradually charge condenser 121 through resistor 82. Obviously since the condenser 121 is in conductive connection with the grid 111, it necessarily follows that the condenser 121 and the grid 111 will have the same potential when the blocking battery 80 is connected thereto. As the charge in the condenser 121 gradually builds up, the potential of grid 111 will also gradually increase, thus resulting in a gradual decrease in the electronic activity of the tube. In other words, the tube 110 will be gradually rendered inoperative. Moreover, by diminishing the electronic emission in tube 110, the intensity of the impulses from record 105 conveyed 104, transmitted to the receiving circuit 55 by this tube, will be gradually diminished. Thus, the music reproduced in the receiving circuit 55, from disc 105, will gradually die out until that tube 110 is rendered completely inoperative.

This third input device 100 can be utilized to musically produce the illusion of approaching and receding bodies. For example, the record 105 may have recorded thereon impulses corresponding to the whistling of a locomotive, the hoofbeats of a horse, the ringing of bells and the like, all of which may be reproduced to produce a given illusion. That is to say, while one of the records 20 or 21 is providing the music, such as is required in connection with a given scene of a moving picture, the record 105 can be gradually reproduced in the receiving circuit 55 to produce an illusion in connection with the music being heard.

Now, of course, it is to be understood that although I have illustrated and described in detail the preferred forms of my invention, the invention is not to be thus limited, but only in so far as defined by the scope and spirit of the appended claims.

I claim as my invention:

1. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of input devices connected to said unit by said circuit adapted to each set up electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for automatically causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of amplifying elements and means for simultaneously increasing the output of one of said elements and decreasing the output of another element.

2. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of input devices connected to said unit by said circuit adapted to each set up electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and electronic means controlled by said selective means and connected to said circuit for causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of electrical valves receiving energy from said input devices and electrical means for decreasing the electron emission in one of said valves and for increasing the electron emission in another of said valves.

3. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of input devices connected to said unit by said circuit adapted to each set up electrical impulses in said circuit, means con-

nected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of amplifying tubes adapted to receive energy from said input devices and electrical means including condensers adapted to contemporaneously increase the electron emission in one of said tubes and to decrease the electron emission in another of said tubes.

4. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, said latter means including a plurality of electron tubes, energy storing means connecting said tubes to said input devices and energy dissipating means connected to said tubes for contemporaneously increasing the electron emission in one of said tubes and for decreasing the electron emission in another of said tubes.

5. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, and means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation.

6. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, and means for controlling this gradual blocking of the tubes.

7. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, said latter means including a plurality of condensers, battery means for charging these condensers adapted to supply the necessary voltage for overloading the tubes, and resistors for controlling the charging of the condensers by said battery means.

8. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, said latter means including a plurality of condensers connected to the tubes and said last mentioned control means including a plurality of resistors for controlling the action of the condensers.

9. In combination, an electrical circuit, a reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, electron tubes in said circuit for amplifying the impulses delivered to said unit, means for blocking the action of said tubes and adapted to contemporaneously cause one of said tubes to be gradually brought into operation and another tube to be gradually blocked from operation, said latter means including a plurality of condensers, battery means for charging these condensers adapted to supply the necessary voltage for overloading the tubes, and resistors for controlling the charging of the condensers by said battery means.

10. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to each set up variable electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for contemporaneously causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components of said input devices including a circuit to be reproduced and pick-up means electrically connected to said circuit and at all times in operative association with the record.

11. In combination, an electrical circuit, an electrical reproducing unit in said circuit, a plurality of variable input devices connected to said unit by said circuit adapted to set up variable electrical impulses in said circuit, means connected to said circuit for selectively causing said devices to be connected to said unit, and means controlled by said selective means and connected to said circuit for automatically causing the devices to at times apply overlapping impulses to said unit, whereby said unit is subjected to an electrical resultant wave, in which wave the impulses from said devices are the components, each of said input devices including a record turntable, a record on the table and electrical pick-up means connected to the circuit and at all times in operative association with the record on the turntable.

12. In an electrical circuit a thermionic tube including a grid, an electrical pick-up connected to said grid, a source of energy, energy storing means, and energy flow resisting means adapted to exponentially increase an electric charge on the grid of the tube to gradually block out the transmission of wave impulses from said pick-up.

13. In an electrical circuit a thermionic tube including a grid, an electrical pick-up connected to said grid, a source of energy, energy storing means, and energy flow resisting means adapted to exponentially decrease an electric charge on the grid of the tube to gradually cause said tube to transmit wave impulses from said pick-up.

14. In an electrical circuit a thermionic tube, an electrical pick-up connected to said tube, a source of energy, condenser means connected to said source, and resistance means connected to said condenser means adapted to exponentially vary the electron emission in the tube so as to vary the transmission of wave impulses from said pick-up through said tube.

15. In combination, a thermionic tube including a grid, an electrical pick-up connected to said grid, and means connected to said grid for gradually energizing said grid beyond the operable capacity of said tube, whereby the action of said tube is gradually blocked to prevent transmission of electrical waves from said pick-up.

16. In combination, a plurality of means adapted to receive and transmit electrical impulses, means for transforming said electrical impulses into audible sound waves, an electrical circuit connecting said receiving means to said transforming means, and means connected to said circuit and acting between said receiving means and said transforming means for automatically and selectively increasing the intensity of the impulses from one receiving means and simultaneously decreasing the intensity of the impulses from another of said receiving means, whereby said transforming means may be subjected to an electrical resultant wave, in which wave the impulses from each of said receiving means are the components.

17. In a record playing machine having two record turntables and a record on each of the said turntables, two oscillable arms, an electric pick-up connected to each of the said arms in operative association with a record, a tone chamber, electric sound transmitting means connected to the tone chamber, means to rotate the said turntables, an electric circuit operatively connecting both of the pick-ups, and means in the said circuit automatically operable upon the closing of the circuit for controlling the sound output of the said pick-ups, and for automatically increasing the output of one pick-up while decreasing the output of the other pick-up to electrically produce sound in said tone chamber from either record as desired.

18. The combination of music synchronizing means for phonographs with two record tables, a record on each of the tables, arms including electric pick-ups in operative association with the said records, and two thermionic amplifiers in a circuit with the said pick-ups, the said means being automatically operable upon the closing of the circuit to gradually increase the electron emission in one of the said amplifiers while gradually decreasing the electron emission in the other of the said amplifiers so as to gradually increase the volume of sound transmitted to a tone chamber from one of the pick-ups and to decrease the volume of sound transmitted to a tone chamber from the other of the pick-ups.

19. In combination, a plurality of records, a plurality of thermionic tubes having grids therein, pick-up means in operative association with the said records and the said tubes, electrical storing means and electrical dissipating means cooperating with a grid in one tube to exponentially increase the electron emission in the said tube, and cooperating with a grid in another tube to exponentially decrease the electron emission in the latter named tube so that the emission in the first named tube is increasing while that in the latter named tube is decreasing.

20. In combination, a plurality of records, thermionic tubes having grids therein, pick-up means in operative association with the said records and the said tubes, electrical storing means and electrical dissipating means cooperating with a grid in one tube to increase the electron emission in the tube, and cooperating with a grid in another tube to decrease the electron emission in the latter named tube while the electron emission in the first named tube is increasing so that the total output of the tubes may be maintained substantially constant while the energy input to the tubes from the pick-up means remains constant.

21. An energy transfer device of the class described, comprising a plurality of thermionic tubes, each having a grid therein, electrical input means in operative association with the said tubes, a source of electrical power, energy storing means connected thereto, energy dissipating means, and switch means adapted to connect the said energy source, and the said energy storing means and the said energy dissipating means in operative association with the said grids to exponentially increase an electric charge on the grid of one tube while exponentially decreasing an electric charge on the grid of another tube.

22. The method of electrically modulating recorded impulses in a reproducing circuit, which consists upon the closing of the circuit in autostatically increasing the intensity of one impulse, decreasing the intensity of another impulse, combining the impulses and transforming the resultant impulses into audible sound.

23. The method of automatically and electrically modulating a plurality of different sources of impulses upon the closing of a reproducing circuit, which consists in varying electrical currents by said impulses, amplifying the resulting currents, automatically increasing the intensity of one of said amplified currents, automatically decreasing the intensity of another of said amplified currents and combining said latter currents for reproduction.

24. The method of automatically and electrically modulating a plurality of different sources of impulses upon the closing of a reproducing circuit, which consists in varying electrical currents by said impulses, amplifying the resulting currents, automatically increasing the intensity of one of said amplified currents, automatically decreasing the intensity of another of said amplified currents and causing said varying currents to overlap each other as they are transmitted into audible sound.

25. The method of maintaining a substantially constant total output to a common receiver from two thermionic amplifying tubes cooperating with two pick-up means in operative association with phonograph records, which consists in exponentially decreasing the electron emission in one tube receiving energy impulses from one record through a pick-up while exponentially increasing the electron emission in the other tube receiving energy impulses from a record through the other pick-up.

26. The method of maintaining a substantially constant output from a plurality of amplifying means, which consists in exponentially decreasing the output of one of the said amplifying means while exponentially increasing the output of the other of the said amplifying means.

27. The method of varying the output of a plurality of thermionic amplifying tubes supplying energy to a common receiver, which consists in exponentially increasing the electron emission in one of the said tubes while exponentially decreasing the electron emission in the other of the said tubes and combining the resultant outputs of the tubes.

28. The method of automatically and electrically modulating impulses from a plurality of different records in a reproducing circuit when the circuit is closed, which consists in varying electrical currents by the recorded impulses, amplifying the resulting electrical currents, automatically controlling the amplification of said currents so as to enable the intensity of certain of said currents to be increased and the intensity of other currents to be contemporaneously decreased, combining said amplified currents of varying intensity and transmitting the resultant current into audible sound of comparatively constant volume.

29. The method of automatically and electrically modulating impulses from a plurality of different records in a reproducing circuit upon the closing of the circuit, which consists in contemporaneously varying electrical currents by the recorded impulses from independent sources, amplifying the resulting electrical currents so as to enable the intensity of one of said currents to be increased and the intensity of another of said currents to be decreased, automatically controlling the amplification of said currents so as to enable the impulses recorded on either of said records to be reproduced when desired, and transmitting the amplified currents into audible sound in such a manner that the change from one record to another cannot be ordinarily detected by the listener.

In testimony whereof I have hereunto subscribed my name at Chicago, Cook County, Illinois.

RAYMOND T. CLOUD.

PLAINTIFF'S EXHIBIT No. 59 862

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Invention Audions. Thermionic Amplifiers

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(No. of Claims Allowed 26) Print Claim 1 (in U.S.C. 25-27)

Title as Allowed Thermionic Amplifiers

Address

TO ALL WHOM IT MAY CONCERN:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at Montclair, in the County of Essex and State of New Jersey, have invented certain new and useful improvements in Thermionic Amplifiers, of which the following is a full, clear, concise, and exact description.

This invention relates to thermionic amplifiers of the audion type.

and its object is to provide a structure by which certain desired characteristics of the amplifier may be secured at will and in an efficient manner. This object is accomplished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in this specification.

In order that the novelty of this invention may be appreciated, and that those skilled in the art may be enabled to use this invention to best advantage, it is necessary that certain terms hereinafter used shall be defined. The following brief discussion is intended to explain the operation of the device and to define the terms to be employed.

The thermionic amplifier consists of a hot electron-emitting cathode, such as the so-called "Wehnelt" cathode, of a cool anode and of an auxiliary electrode called the grid, which is usually, though not always, located between the anode and the cathode. A battery is connected so as to force the electrons liberated at the cathode toward the anode, thus setting up a convection current carried by electrons in the evacuated space. In this specification since only the structure of the device itself is under discussion, only the effects of changes in that structure are considered. Obviously a change in the battery will also change the characteristics of the circuit, but in a way which is already known in the art. Due to the presence of these electrons, a negative space charge is established between the anode and the cathode, whose effect is to limit the number of electrons which can leave the cathode, and consequently to limit also the current which can flow in the output circuit, by which is meant the circuit including the battery and the path of the space current. The object of the grid is to furnish a means for introducing a further negative charge into the space between the anode and the cathode, or for introducing into it a positive

charge which shall neutralize the effect of part of the space charge due to the electrons. In the first case, the convection current is decreased; in the second it is increased. In order to force this charge to the grid, a source of electromotive force is connected between grid and cathode, that is, between the input terminals of the device. The effect of such an impressed electromotive force is therefore to alter the magnitude of the space current in the amplifier by changing the distribution of space charge between the electrodes, and moreover this is accomplished without requiring that the impressed electromotive force shall do more work than that involved in forcing the charge to the grid against the counter voltage of the condenser formed by grid and filament. Since in this operation the change in power consumed in the output circuit may be much greater than that required in charging the condenser, the device acts as an amplifier. This variation in space current, due to an impressed electromotive force, will hereafter be called the output current of the amplifier and the variation in voltage, which appears in the output circuit due to the impressed electromotive force, will be called the output voltage. The reason for adopting these definitions is that in the practical applications of the amplifier it is only these variations in current or voltage which are utilized; in fact, a transformer is ordinarily used to derive power from the output circuit, and obviously the steady space current or the steady output voltage have no effect in the secondary of that transformer and may be ignored for practical purposes. Thus, the term voltage amplification means here the ratio of the alternating voltage appearing in the [illegible] of such a unity ratio transformer to the alternating voltage impressed across the filament and grid, when the transformer primary is made to include the whole of the output circuit external to the amplifier. In simpler terms, it is the ratio of the above defined output voltage to the impressed input voltage.

There will also be occasion to consider the ratio of output current to input voltage, the latter being taken as standard throughout. When this ratio is high, other things being the same, the amplifier will be said to be of the high current type, and vice versa. This latter ratio is, of course, not a pure number, but is of the nature of an admittance.

It has been found that amplifiers may be designed for given circuit conditions so that they will have whichever of the above mentioned characteristics is desired. That is, one may be designed to deliver to a receiving device a comparatively high voltage with a low current, or vice versa. The principles of operation which have been discovered which enable this result to be accomplished may be stated as follows.

In the first place it has been found that it is of advantage to locate the grid as near the cathode as possible whatever the desired voltage amplification or output current. In practice it has been found that when the two elements are separated only by a mere oxidizing coating the most efficient action is obtained. Unless there is a solid and continuous spacing element between the two it may be necessary, of course to separate them a small distance to prevent actual contact between them due to forces set up during operation. By saying that the elements are placed as close together as possible it is meant that the distance between them is made as small as possible without introducing appreciable electrical or mechanical disturbances during operation.

Again, it has been found that, when the cathode and grid are placed as near to each other as possible, decreasing the distance from the anode to the cathode decreases the voltage amplifying power of the tube without at the same time reducing the variable current set up in the output circuit. That is, if we consider two tubes, one of which has the anode and cathode widely spaced while the other has them near together, the grid being very close to the

cathode in each case, the first tube when installed in a system of the usual kind tends to cause marked voltage amplification, while the latter as substitutes for the former increase the variable current output and at the same time lowers the voltage amplification.

A third principle of operation of the thermionic repeater which has been discovered may be stated as follows. To increase voltage amplification decrease the ratio of open space in the grid to conducting surface, and to decrease voltage amplification or to increase the variable output current increase this ratio.

The behavior of thermionic repeaters in another very important respect has been discovered. This may be stated as a fourth principle of operation as follows: Maximum efficiency is obtained when the impedance between the anode and cathode is equal to the total impedance of the variable current consumption circuit. This total impedance includes the total line impedance and that of the receiving or translating device or devices to which power is being supplied.

It has been found that tubes may be constructed in such manner as to take advantage of any number or of all of the above mentioned principles with, of course, correspondingly increased efficiency and adaptability.

The invention will be better understood by reference to the following specification taken in connection with the accompanying drawing in which

Fig. 1 represents the structure of an amplifying tube which is designed to give greater voltage amplification than those of the prior art; Fig. 2 is a plan view of the amplifier of Fig. 1 arranged to exhibit the geometrical configuration; Fig. 3 is a view of a tube structure designed to give a large output current with low or negative voltage amplification; Fig. 4 is a plan view of the structure of Fig. 3; Figs. 5 and 6 are views corresponding

to Figs. 3 and 4 respectively of a modified structure of the same type of amplifier; Fig. 7 is a circuit diagram showing an amplifying system making use of an amplifier of the type shown in Fig. 1; Figs. 8, 9 and 10 are circuit diagrams showing several forms of circuit making use of an amplifier of the kind shown in Fig. 3. In these figures, like numerals represent corresponding parts.

Referring to Figs. 1 and 2, 1 represents the grid element, 2 the cathode or filament and 3 the anode or plate. The plate is placed a considerable distance from the cathode, and the grid is placed very close to the cathode and may be separated therefrom only by a thin insulating film as, for example, an oxidizing coating on one or the other of these elements. Further, the grid is made to have a fine mesh and thus to obstruct greatly the view of the plate as seen from the cathode.

Figs. 3 and 4 are two views of a thermionic amplifier of the high current type. In these structures, in conformity with the above mentioned principles, the distance from plate 3a to cathode 2a is made very small, and the grid 1a is placed as close as possible to the cathode. Further, the grid 1a is made to have a coarse mesh, or is constructed to have a large ratio of open space to conducting surface, as is required by the conditions above set forth for this type of amplifier.

Figs. 5 and 6 show another modification of the high current type of amplifier. The input electrode or grid is in the form of a wire 1b, bent back at its middle. In effect, therefore, the input electrode consists of two wires joined together. The filament 2b is wound about the input electrode and is insulated therefrom by a tube of insulating material 4, an arrangement which is not the invention of this applicant, but is described and claimed in patent 1,169,[illegible] of Jan. 25, 1916 to Alexander McLean Nicolson. The output electrode or anode consists of two plates 3b, 3c arranged upon opposite sides of the filament and close to it. It will be noted that the input electrode is not located between the filament and plate, such not being necessary in this high current type of tube.

Fig. 7 is a diagram of an amplifying system in which a tube V of the type shown in Fig. 1 is employed. The tube has the usual input circuit 4, 4 and output circuit 5, 5. The exact arrangement of input and output circuits is that shown in patent 1,125,142 to this applicant. In this patent there is shown and claimed a combination of the systems of the types shown in Figs. 7 and 8 respectively of this application, such combination having marked advantages for certain purposes specified in said patent. The purpose of the present application is to specifically describe and claim these types of systems employing novel thermionic amplifiers, these being capable of more general use than that disclosed and claimed in the above mentioned patent.

A source of potential 7 may be inserted in the input circuit to bring the grid to a desired initial or working potential. No transformer need be used, the incoming line being directly connected to the input electrodes, and the outgoing line, to the output electrodes. A high resistance element 6 may be connected across the input circuit as shown. A coil 8 of large inductance provides a path for direct current for the tube V, such current being supplied by a source B. The coil 8 will not constitute an appreciable amount of the variable current in the output circuit owing to its high impedance to such current. The condenser 9 is inserted in the line to prevent flow of direct current from the source B through the receiving device 10 if the latter does not itself prevent such flow.

The receiving device 10 may be one which operates most efficiently upon high variable voltage and low current. In accordance with the principles discussed above, the grid1 and cathode 4 are placed very close together while the plate 5 is widely separated from the cathode, the distance between the two being that necessary to give the desired current and voltage output characteristics. It is usually necessary however for efficient operation to consider first the impedance characteristics of the tube between filament and plate and the receiving device and line, in accordance with the fourth principle of operation stated above. The receiving device

10 is one of high impedance and accordingly the impedance of the tube between filament and plate is made high, the two impedances being made as nearly the same as possible consistent with other possible conflicting requirements. They should at least be of the same order of magnitude, for example one being 100,000 ohms and the other 25,000 ohms. The receiving device 10 may be a second amplifying tube or similar device.

Fig. 8 is a diagram of a system the same as that of Fig. 7 except that a receiving device having relatively low impedance or operating efficiently upon relatively large variable current and low voltage, or both, is present. Accordingly, the anode 3a and cathode 2a of the tube are placed relatively near together, the grid 4a being as before very close to the cathode. The impedance of the amplifier between filament and plate is made the same as that of the receiving device 11, or as nearly the same as other operating conditions will permit, and at least of the same order of magnitude.

It has been found that in accordance with this invention an amplifier of the type shown in Fig. 8 may be constructed which will develop amplified energy at a voltage one third of the voltage of the input energy and having an anode-to-cathode impedance as low as 500 ohms. Such an amplifier can, then, be worked efficiently into a receiving device or line having this relatively low impedance and the efficiency with a receiving device of even much lower impedance would be relatively high - much higher than that heretofore attainable.

Fig. 9 shows the same circuit as Fig. 7 except that a high resistance element 15 is substituted for the coil 8, this resistance being so large that the variable current through it is negligible. The high-current, low-voltage-amplification type of amplifier is here shown, a tube impedance of the same order as that of the telephone receiver 18 being thus obtained.

In Fig. 10 is shown a system similar to that of Fig. 8 except that input and output transformers, 16 and 19 respectively are employed. Except for the tube structure systems of this kind

have been in use for some time. The elements of the tube are here spaced and the grid constructed in accordance with the principles herein disclosed, the tube being of the type illustrated in Fig. 5. The impedance of the primary winding 17 of the transformer 18 is low and accordingly the cathode-to-anode impedance is made of the same order, the ratio of the number of turns of coil 18 to that of coil 17 being the same as the ratio of the impedance of receiving device 19 to that of the primary winding 18. A direct current dynamo D' is here shown as the source of space current, it being understood of course, that the type of source used is immaterial. An impedance coil 22 may be inserted in series with the source D' to reduce the current variations set up by the commutator of the machine. These variations may be of frequency quite different than that of the variable current set up by the tube V', so that the coil 22 may discriminate between them. If the impedance of the primary coil 17 is high, as might be the case if it were desired to use a step down transformer, the cathode-to-anode impedance of the tube V' would of course be increased the desired amount.

By thermionic repeater is meant a repeater depending for its operation upon current discharge from a heated cathode. It is obvious, however, that the invention might be applied to a discharge device in which other means is employed for liberating electrons from the cathode. In its broadest aspect the invention is not limited to the particular structure herein illustrated, but may be found useful in modified forms of types of discharge tubes and in connection with a variety of circuit arrangements.

~~This application is a continuation of application Serial No. 241,261, filed Aug. 28, 1914.~~

WHAT IS CLAIMED IS:

1. A thermionic discharge tube having a cathode, an anode and a controlling electrode, said anode being located in such close proximity to the cathode that the tube operates to produce energy amplification without substantial voltage amplification.

2. A thermionic discharge tube having a cathode, an anode, and a controlling electrode, said controlling electrode and said anode being located in such close proximity to the cathode that the tube operates to produce energy amplification without substantial voltage amplification.

3. A thermionic discharge tube having a cathode, an anode and a controlling electrode, said anode being located in such close proximity to the cathode as to keep the internal impedance of the tube sufficiently low to permit of energy amplification without substantial voltage amplification.

4. The combination with a thermionic discharge tube having a cathode, an anode, and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit,

and translating means for utilizing the variable current of said output circuit, said cathode being located so close to both said anode and said impedance varying element, that, for the impedances and voltages employed outside the tube, the tube operates to amplify the energy in said input circuit without amplifying the voltage.

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5. The combination with a thermionic discharge tube having anode, a cathode, and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being placed as close as possible to the impedance varying element so that, for the impedances and voltages employed outside the tube, the tube operates to amplify the energy in said input circuit without amplifying the voltage.

6. The combination with a thermionic discharge tube having a cathode, an anode and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said impedance varying

element being in immediate proximity to the cathode but out of electrical contact therewith, and closer to the cathode than to the anode, so that for the impedances and voltages employed outside the tube, the tube operates to amplify the energy in said input circuit without amplifying the voltage.

7. The combination with a thermionic discharge device having a cathode, an anode and a control element, of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and control element being so spaced that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

8. The combination with a thermionic discharge device, having an anode, a cathode and a control element, of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and control element being so spaced that the impedance of said discharge device between said anode and said cathode is approximately the same as that of said outgoing circuit.

9. The combination with a thermionic discharge device having a cathode, an anode, and a control element, of an input circuit connected to said cathode and said control element, an outgoing circuit

having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said control element but out of electrical contact therewith, and said anode being so spaced from said cathode and control element that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

10. The combination with a thermionic discharge device having a cathode, an anode, and a grid, of an input circuit connected to said cathode and said grid, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said grid but out of electrical contact therewith, and said anode being so spaced from said cathode and grid and the said grid being of such source such that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

11. The combination with a thermionic discharge device having a cathode, an anode and a control element, of an input circuit connected to said

cathode and said control element, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said control element but out of electrical contact therewith, and said anode being so spaced from said cathode and control element that the impedance of said discharge device between said anode and said cathode is approximately the same as that of said outgoing circuit.

12. The combination with a thermionic discharge device having a cathode, an anode, and a control element, of an input circuit connected to said cathode and said control element, an outgoing circuit having impedance and connected to said anode and said cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode, anode and control element being so placed that the impedance of that portion of the input circuit which is within the discharge device is made as small as possible without introducing disturbing mechanical or electrical variations under working conditions, and the impedance of that part of the outgoing circuit which is within the discharge device is made of the same order as that of the effective impedance of that part of the outgoing circuit which is external to the discharge device.

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15. The combination with a thermionic discharge device having a cathode, an anode, and an impedance varying element, of an input circuit and an output circuit therefor, an impedance element in said output circuit, means for producing a variable electromotive force in said input circuit, and a source of electromotive force in said output circuit, said cathode being as near as possible to said impedance varying element and said anode being relatively widely spaced from said cathode, whereby the variable voltage across said anode and cathode in said output circuit is much greater than that in said input circuit.

16. The combination with a thermionic discharge device having a cathode, an anode, and an impedance varying element, of an input circuit and an output circuit therefor, an impedance element in said output circuit, means for producing a variable electromotive force in said input circuit, and a source of electromotive force in said output circuit, said cathode being in immediate proximity to said impedance varying element and said anode being relatively widely spaced from said cathode and said impedance varying element being in the form of a non-inductive conductive strip, the ratio of conductive surface to open space in said impedance varying element being high, whereby the variable voltage across said anode and cathode in said output circuit is much greater than that in said input circuit.

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13 D. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit.

14 D. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit non-magnetically connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit.

15 D. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit, the variable power delivered to said work circuit being much greater than that supplied by said input circuit, while the variable voltage delivered is correspondingly less than in said input circuit

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Rejected Apps 1-14, 16-26

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IN WITNESS WHEREOF, I hereunto subscribe my name this 24th day of July A.D., 1915.

Harold D. F. Arnold

OATH

State of New York)
County of New York) ss.

HAROLD D. F. ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Maplewood, in the County of Essex and State of New Jersey, and that he verily believes himself to be the original, first, and sole inventor of the improvement in THERMIONIC AMPLIFIERS, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to the application of which this is a continuation, or in public use or on sale in the United States for more than two years prior to the application of which this is a continuation; that the said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to the application of which this is a continuation; and that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the United States.

Harold D. F. Arnold

Sworn to and subscribed before me this 24th day of July 1915.

Notary Public

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Div. 16 Room 112 Add. 2-200

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

Paper No. 3

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Oct. 26, 1918.

U. S. PATENT OFFICE
OCT 28 1918
MAILED

John S. Roberts, Esq.,
220 Broadway,
New York, N.Y.

Please find below a communication from the EXAMINER in charge of the application of

Harold De F. Arnold, Ser. No. 247,422, filed July 30, 1918,

Audions.

James T. Newton
Commissioner of Patents.

This application has been examined.

Applicant's residence is given in the petition and oath is Maplewood, New Jersey, while in the preamble to the specification it is given as East Orange, New Jersey. Uniformity is required.

Page 6, line 4, "7, 8 and 9" should be 8, 9 and 10.

Claim 17, lines 12 and 13, the expression "while the variable voltage delivered is correspondingly less" is not clear as the claim does not indicate with what the voltage delivered is compared.

Claims 1, 2, 3, 4, 5, 6 and 12 are objectionable in view of the negative limitation beginning with "without". These claims differ only in that negative limitation from the usual amplifying audion, such as is shown in Fig. 43 on page 65 of The W. eless Telephone, by H. Gernsback, 2nd Edition, published by the Modern Publishing Co., 233 Fulton Street, New York City, 1911.

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Ser.No. 247,422. #2.

At present there is not a clear line of division between this application and application No. 235,043. See claims 7 to 12, 15 and 16 of this application and claims 12, 13, 14 and 15 of application No. 235,043.

Claims 7 to 12, 15 and 16 are rejected on patent No.1,129,959, COLPITTS, Mar. 2, 1915 (179-171). The group of audions are arranged so that their internal impedance is of the same order as the impedance of the output circuit.

Claims 13 and 14 are specific to species of applicant's invention different from that to which claims 1, 2, 3 are directed. Division is accordingly required.

As the subject-matter of this application has been pending for more than four years, a prompt reply is requested.

Examiner, Division 16.

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RIIS.

Case 882

PAPER NO 4
AMENDMENT a

MAIL ROOM MAY 2 1919 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division ..... Room .....

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In re application of

Harold DeForest Arnold

Serial No. 247,422

Filed July 30, 1918

Subject.

Audions

PATENT OFFICE
MAY 3 1919

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Please amend the above entitled application as follows:

Page 1, line 3, change "East Orange" to --Maplewood--.

Insert the following at line 25, page 5:

The object of this invention is to provide an audion, or an equivalent device, which will amplify the variable energy supplied thereto without at the same time causing a large voltage amplification, as in systems of this type heretofore used. Or, differently stated:

To provide an audion, or equivalent device, which will cause the amplified energy which appears in the output circuit to take the form of large variable current, rather than smaller variable current with large voltage amplification.

Another object is to provide an audion, or equivalent, system by which a proper impedance ratio is obtained between the impedance of that portion of the output circuit which is without the audion and that of the remaining portion of the external circuit, whereby a greatly increased efficiency is obtained.

A further object of the invention is to provide an audion, or equivalent device, which will operate with increased efficiency when the translating device to which the amplified energy is supplied in the output circuit of the device is one which operates best upon maximum variable current, as distinguished from one which operates best upon maximum variable voltage.

Another object of the invention is to provide an audion, or equivalent device, which will operate efficiently with a current operated translating device without the use of a voltage transformer between the audion and the translating device.

Viewed broadly, the invention provides for an increase of the efficiency of an audion, or equivalent device, by novel spacing of the electrodes and the current

(Serial No. 847,422)

control element, and also an increase of efficiency, when used with a current operated translating device, by obtaining the proper ratio of the conductive surface to open space in the grid or current control element.

Other and more specific objects of invention will be apparent from the appended claims.

Page 6, line 4, change "7, 8 and 9" to --8, 9 and 10 respectively.--

Cancel lines 31 and 32, page 9.

Cancel claim 5 and substitute therefor the following:

5. The combination with a thermionic discharge device having an anode, a cathode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being placed so close to said grid and said grid being of such fine mesh that, for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

(Serial No. 267,482)

out amplifying the voltage.14

Cancel claims 13 and 14, renumber the remaining claims as 13, 14 and 15.

Claim 15, former claim 17, cancel the period at the end of the claim and add --therein in said input circuit.--

Add the following claims:

A3

16. Means for amplifying energy without substantial voltage amplification, comprising a vacuum discharge tube having an input and an output circuit, a source of variable energy to be amplified connected in said input circuit, and a translating device to which the amplified energy is delivered connected in said output circuit.

17. Means for amplifying energy without substantial voltage amplification comprising an electric discharge device having an anode, a cathode and a current control element, an input circuit and an output circuit for said device, a source of variable energy to be amplified connected in said input circuit, and a translating device to which the amplified energy is delivered connected in said output circuit.

18. Means for amplifying energy without substantial voltage amplification comprising an electric discharge device having an input circuit and an output circuit, a translating device to which the amplified energy is delivered connected in said output circuit, the impedance of that portion of said output circuit which is within said discharge device being of the same order of magnitude as the impedance of said translating device.

19. The combination with an electronic discharge device having an anode, a cathode and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said impedance varying element being in the form of a discontinuous conductive surface, the ratio of conductive surface to open space being so low that, for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

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20. The combination with an electronic discharge device having a cathode, an anode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said anode being so close to said cathod and said grid being of such coarse mesh that, for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

21. The combination with a thermionic discharge device having a cathode, an anode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being located in immediate proximity to said grid but out of contact therewith, and the grid being of

such source such, that for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

28. The combination with an electronic discharge device having a cathode, an anode and a grid, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said cathode being placed in immediate proximity to said grid, but out of contact therewith, said anode being so close to said cathode, that for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

29. The combination with an electronic discharge device having a cathode, an anode and an impedance varying element, of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of

electromotive force in said output circuit and translating means for utilizing the variable current of said output circuit, said cathode, anode and impedance varying element being so spaced that for the impedances and voltages employed outside said device, the device operates to amplify the variable energy in said input circuit without amplifying the voltage.

24. Means for amplifying energy without substantial voltage amplification comprising an electric discharge device having an anode, a cathode and a current control element, an input circuit for said device, a source of variable energy to be amplified connected in said input circuit, and a work circuit to which the amplified energy is delivered non-magnetically connected in said output circuit.

25. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode in immediate proximity to said cathode but out of electrical contact therewith and closer to said cathode than to said output electrode.

47 30

(Serial No. 847,422)

26. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode as close as possible to said cathode without contacting therewith and closer to said cathode than to said output electrode.

REMARKS

Claims 13 and 14 have been cancelled in response to the requirement for division and with no intention of abandoning the subject matter.

Claims 16 to 26, inclusive, are added to more completely protect the invention.

Claims 25 and 26 are allowed claims 1 and 2, respectively, of applicant's pending application, Serial No. 841,567. Applicant desires it to be understood that this application is a continuation of application, Serial No. 841,567 and also of the application upon which issued patent No. 1,129,942 to this applicant.

Claim 15, former claim 17, has been amended to overcome the objection noted by the Examiner.

Reconsideration of the objection to claims 1, 2, 3, 4, 5, 6 and 12 is respectfully requested. Claim 1, for example, does not read upon the system shown in "The Wireless Telephone", since it does not disclose an anode located in such close proximity to the cathode that the tube operates to produce energy amplification without substantial voltage ampli-

47 31

(Serial No. 347,422)

fication. This is a structural limitation and is clear and definite. It is understood that there can be no objection to a negative limitation which does not introduce indefiniteness or ambiguity into the claim. It is therefore submitted that applicant is entitled to these claims.

The Examiner is asked to reconsider the question of a line of division between this application and application No. 225,043. The claims of this application which the Examiner cites as covering the same matter as claims of the application No. 225,043 contain limitations which would prevent the claims from being made in the latter application, see for example, claims 9, 10, 11 and 12 and former claim 16. It is questionable also whether claims 7, 8, 9 and 15 could properly be made in the application 225,043, as the latter application does not disclose the spacing of the electrodes for the purpose indicated. If, however, the Examiner is still of the opinion that there is not a line of division between the two applications, no objection will be made to establishing a proper line.

An affidavit under Rule 75 is filed herewith to overcome the effect of the Colpitts patent No. 1,229,959.

Respectfully,

HAROLD DeFOREST ARNOLD,

By J G Roberts
Attorney

920 Broadway,

New York, May 1st, 1919.

CAS:T
Enclosure

MAIL MAY 2 1919 U.S. PATENT OFFICE

892
#4

UNITED STATES PATENT OFFICE

State of New York }
County of New York } ss.

MAY 3 1919

Harold DeForest Arnold, whose application for improvements in Audions, Serial No. 247,422, was filed in the United States Patent Office on or about July 30, 1918, deposes and says:

That prior to April 6, 1914, he made the invention disclosed in the attached sketch marked "Arnold Case 8-A Exhibit 1"; that prior to April 6, 1914, he disclosed said invention to Mr. P. H. Pierce and others; that said sketch is an accurate copy made by tracing of an ink sketch made prior to April 6, 1914, in a research note book to record the result of work done by said Pierce under his, Arnold's direction; that during said work, said invention was operated successfully; that the internal impedance between the plate and filament of the left-hand vacuum tube in the sketch of said exhibit was of the order of magnitude of the joint impedance of the element marked "100,000 ω" and the internal input circuit impedance of the right-hand tube of the sketch of said exhibit; that he does not know and does not believe that the invention has been in public use or on sale in this country, or patented or described in a printed publication in this or any foreign country for more than two years prior to his application, and that he has never abandoned the invention.

Harold DeForest Arnold

Sworn to and subscribed before me this
1st day of May, 1919.

Walter E. Fenton
Notary Public.

APPROVED
June 24, 1919
Chief Clerk
Law Examiner

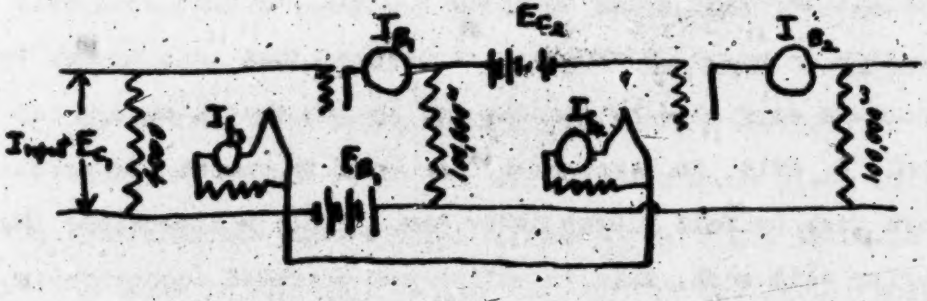
EVG LM

MAIL ROOM MAY 3 1919 U.S. PATENT OFFICE

PATENT MAY 3 1919 DEC. 10 FILED

#4

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Arnold Case 8A Exhibit 1.

PLAINTIFF S' EXHIBIT No. 60 894

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

To all persons to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of the

Letters Patent of

Harold D. Arnold, Assignor to
Western Electric Company, Incorporated,

Number 1,403,475, Granted January 17, 1922,

for

Improvement in Vacuum-Tube Circuits.

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this twenty-third day of October in the year of our Lord, one thousand nine hundred and twenty-nine and of the Independence of the United States of America the one hundred and fifty-fourth.

ATTEST:

Chief of Division.

Thomas E. Robertson
Commissioner of Patents.

This invention relates to vacuum tube circuits and particularly circuits of the type in which a plurality of vacuum tubes are arranged in tandem.

The object of the invention is to provide an improved circuit connection between vacuum tubes whereby fluctuations of current in the output circuit of one vacuum tube may be impressed on the input circuit of another vacuum tube.

In accordance with this invention, the output circuit of a vacuum tube is provided with a path for direct current comprising an impedance, preferably a resistance, and the input circuit of the succeeding tube is connected across a portion of the direct current path containing said impedance. A condenser is placed between the direct current circuit and the second tube to prevent the flow of direct current, and a direct connection is also made between the input electrodes of the second tube so that a normal potential difference may be applied therebetween.

The invention further resides in the specific details of the circuit hereinafter to be described, and shown in the accompanying drawing, in which the figure represents, schematically, a circuit embodying the invention.

The subject matter of this application is divided out of application Serial No. 48,873, filed September 3, 1915, for [illegible] communication.

Reference numerals are used in this application corresponding to those used in the application above referred to.

Coil 18, which may be connected to any suitable circuit upon which electric impulses may be impressed is inductively connected with the tuned circuit comprising coil 19 and condenser 20. Across the terminals of condenser 20,

423259-3

is connected the input circuit of a detecting device which comprises vacuum tube 21, condenser 22 and resistance 23. For the detection of modulated high frequency signals the purpose of the combination of the condenser and high resistance in connection with vacuum tube 21 is as follows - when a positive charge, for example, is forced upon the grid 9 of element 21, this charge is neutralized by electrons from the filament 8. Then, when a negative charge is forced upon the grid by the incoming wave, this charge adds to that already present and produces a still larger negative charge upon the grid, since the negative charge cannot be neutralized by the electron stream. The condenser, therefore, aids in decreasing the average current in the output circuit. The grid must, however, be conductively connected to the incoming circuit, otherwise the accumulated negative charge would remain and prevent further operation. To provide for this, a high resistance leakage path 23 is shunted around the condenser 22 to allow a leak, slow compared with the period of high frequency currents, but still rapid enough to permit considerable leakage in a time comparable with a period of telephonic waves.

The output circuit of this vacuum tube is supplied with current by battery 27 coming through choke coil 28 and resistance 25, to the anode 10 condenser 24 serving as a high frequency shunt and condenser 26 to limit the direct current to the detector circuit. The amplifier tube 31 has a battery 30 in series with its grid with resistance 29 across its input circuit. The output circuit of amplifier 31 comprises a battery 34 and choke coil 35, both shunted by condenser 33, and a coil 32. Coil 32 is inductively associated with coil 36 which may be connected to any suitable circuit for the utilization of the amplified currents.

While a circuit has been shown which is especially adapted for the detection and amplification of modulated high

4=3237-4

frequency currents, it is obvious that the features of the circuit relating to the object of this invention are adapted for use in repeating electrical impulses of other forms.

(X)

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RAW:MHL.

l.c.

4. WHAT IS CLAIMED IS:

1. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and an impedance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said impedance, and means for applying a steady difference of potential between said input electrodes.

2. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and a resistance connected to said electrodes, and a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said resistance, and means for applying a steady difference of potential between said input electrodes.

3. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and an impedance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said impedance, and a conductive path between the input electrodes of said second tube.

4. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and a resistance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across a portion of said first path containing said resistance, and a conductive path between the input electrodes of said second tube.

899

Harold De Forest Arnold - 1925

5. In combination, a vacuum tube having output electrodes, a path comprising a source of direct current and a resistance connected to said electrodes, a second path comprising a condenser and the input electrodes of a second vacuum tube connected across that portion of said first path comprising said resistance and said source of direct potential, and a conductive path between the input electrodes of said vacuum tube.

6. In combination, two vacuum tubes, a circuit connecting the output electrodes of one of said tubes to the input electrodes of the other of said tubes, said circuit comprising a series condenser and a shunt impedance at each side of said condenser.

7. In combination, two vacuum tubes, a circuit connecting the output electrodes of one of said tubes to the input electrodes of the other of said tubes, said circuit comprising a series condenser and a shunt path at each side of said condenser, each of said paths comprising a resistance.

8. In combination a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser.

9. In combination, a circuit comprising a resistance, a source of direct current and means for producing variations in said current, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser.

1423-11

denser.

10. In combination, a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, connections for impressing said variations on said electrodes, said connections comprising a series condenser, and a resistance shunt for said input electrodes.

11. In combination, a circuit for the reception of modulated high frequency currents, a vacuum tube for detecting and amplifying said currents, said vacuum tube having an impedance in its output circuit, and a circuit connected substantially in parallel with said impedance for impressing variations in the output circuit on another amplifier, said second circuit comprising a series condenser.

12. In combination, a circuit for the reception of modulated high frequency currents, a vacuum tube for detecting and amplifying said currents, said vacuum tube having an impedance in its output circuit, a circuit connected substantially in parallel with said impedance for impressing variations in the output circuit on another amplifier, said second circuit comprising a series condenser, and a shunt conductance.

13. A detector and amplifier of high frequency currents having in its output circuit a source of direct current, an inductance and a resistance in series, an amplifier having its input circuit in parallel with said series circuit, and a path of low impedance having one terminal in common with said circuits, and its other terminal connected between said resistance and said inductance.

1,423,259-8

~~Harold De Forest Arnold~~

14. A detector and amplifier of high frequency currents having in its output circuit a source of current and an inductance, a translating device having an input circuit connected in parallel to a portion of said output circuit containing said inductance, and a path of low impedance to high frequency current connected in parallel to a portion of said output circuit containing said inductance.

Cl. 15

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l.c.

IN WITNESS WHEREOF, I hereunto subscribe my name, this 5th day of November, A. D. 1920.

Harold D. Arnold

State of New York }
County of New York } ss.

HAROLD DE FOREST ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Maplewood, in the County of Essex and State of New Jersey, and that he verily believes himself to be the original, first and sole inventor of the improvement in VACUUM TUBE AMPLIFIERS, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to the application of which this is a division, or in public use or on sale in the United States for more than two years prior to the application of which this is a division; that said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to the application of which this is a division; that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the United States, prior to the filing date of the application of which this is a division; that the subject matter claimed herein was a part of his invention disclosed in the application of which this is a division, was invented before he filed said application and has not been abandoned.

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Harold O. Arnold

Sworn to and subscribed before me
this 5th day of November, 1926.

Jacob F. Gilbert

NOTARY PUBLIC
New York Co. Clerk's No. 81
Commission Expires March 31, 1928

[redacted] Form 118 120 [redacted]

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON, Feb. 8, 1921.

U. S. PATENT OFFICE
FEB 2 1921

Mr. John G. Roberts,
445 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of
Harold D. Arnold. Ser. No. 425,259, filed Nov. 12, 1920.
Vacuum Tube Circuits.

R. F. Whitehead
Commissioner of Patents.

This application has been examined.

Claims 3, 4, 5, and 8 to 12 are rejected as involving no invention over

ARNOLD, 1,114,865, Oct. 27, 1914, 179-171.

It should be noted that in Fig. 3 of the patent, the input terminals of a second amplifier might well, and without invention, be substituted for the primary coil of transformer 6. Additional stages of amplification may obviously be inserted whenever desired.

All other claims appear allowable.

Inasmuch as this application has an effective filing date of five years or more, it comes within Commissioner's Order 2210, 316 O. G. 1, respecting delayed applications, and applicant is, therefore, strongly urged to present an early response, placing this case in condition for final action before the examiner.

Exr., Div. 16.

B.

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APR 3 1921
U.S. PATENT OFFICE

Case 16d

PAPER NO. 3
AMENDMENT A

UNITED STATES PATENT OFFICE.

Division 16 Room 118

26

In re application of

HAROLD D. ARNOLD

Serial No. 435,859

Filed November 11, 1920

Subject.

VACUUM TUBE CIRCUITS.

PATENT OFFICE
APR 4 1921

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office Action of February 2, 1921, please amend the above entitled application as follows:

Add the following claim:

15. In combination, a vacuum tube having output electrodes, a path for direct current comprising said output electrodes, a source of current and an impedance, and a path for alternating currents comprising a condenser and a work circuit, said second path being in parallel to a portion of said first path containing said impedance.

REMARKS

Reconsideration of the rejection of claims 3, 4, 5 and 8 to 13 on Arnold patent No. 1,114,845 is respectfully requested. It is believed that invention was involved at the applicant's original filing date in substituting a vacuum tube amplifier for the transformer 6 shown in applicant's prior patent. A vacuum tube when employed as an amplifier draws substantially no current from its input circuit, being operated

42: 207-10

substantially wholly by the static effect of changes in input potential. It was not obvious that the high impedance, potential operated vacuum tube would operate satisfactorily if substituted for the low impedance, current actuated work circuit of the reference patent. This is borne out by the fact that no prior inventor had hit upon this arrangement, although the three electrode vacuum tube had been known for many years. The arrangements which had been suggested by prior inventors for connecting tubes in tandem are not so satisfactory for ordinary repeater work as that claimed in this application. Prior schemes are shown in the following patents: Von Lieben, Reisz and Strauss, French Addition 15,786 published June 17, 1911. This patent shows a transformer connection between tubes. A transformer is an expensive piece of apparatus, and furthermore is not equally efficient at all frequencies. DeForest patent 1,177,848, April 4, 1916, originally filed June 24, 1915, shows a metallic connection between tubes with a shunt inductance for the space current, but shows no means for controlling the steady potential for the grid of the second tube. Langmuir patent 1,282,489, October 22, 1918, filed October 29, 1915, in Fig. 1, shows an arrangement in which a resistance is employed in the location of DeForest's shunt inductance, and battery is added for controlling the grid potential. This battery, however, is conductively connected to the battery supplying space current to the first tube, and as a result it is more difficult than applicant's circuit to maintain in proper adjustment. This circuit has been found to be of practical utility in laboratory instruments. In applicant's circuit the grid potential battery is separated

from the direct current circuit of the preceding tube by a condenser which can very inexpensively be made large enough that it will not appreciably impede the transmission of telephone currents. Another example of a circuit for connecting tubes in tandem is Pierce patent 1,112,658, October 6, 1914, filed August 5, 1913. The circuit of this patent appears to depend for its operation on the presence of gas in the second tube and would not be operative if pure electron discharge tubes were used.

For the above reasons it seems clear that the arrangement set forth in the rejected claims is patentable over the disclosure of the applicant's prior patent. Claims 3, 4, 8, 10 and 12 also call for a conductive shunt between the input electrodes of the second tube. The Examiner has cited no reference showing this feature.

Furthermore, in view of ex parte Mullen and Mullen 50 O.G. 497, it is believed that applicant is entitled in this application to make claims, regardless of whether they involve patentable novelty over this feature of applicant's prior patent. The claim in the prior patent relates to the use of a resistance in the output circuit of the vacuum tube for preventing blue haze. The arrangement shown in Fig. 3 for separating the next circuit from the direct current by means of a condenser is not claimed and it is believed that there is no presumption of dedication of the public on account of the failure to claim it in the patent. This is believed to come clearly within the third class of cases referred to in

423,259-10

ex parte Mallon. The claims now being made in this application are for an invention which is independent of that claimed in the patent and the Office no doubt would have required division between said claims and the claim for means for preventing blue haze, if claims to both features had been made in the prior application. Accordingly new claim 15 has been added to cover the arrangement shown in Fig. 3 of patent No. 1,114,845 and allowance of this claim is respectfully requested. Regardless of the action that may be taken on claim 15, applicant for the reasons given above is of the opinion that claims 3, 4, 5 and 8 to 12 inclusive are clearly patentable over the disclosure in the prior patent.

Favorable consideration and allowance of the claims is respectfully requested.

Respectfully,

HAROLD D. ARNOLD

By W. G. Beath
Attorney.

463 West Street,
New York, March 7 April 1921.

HAR:Qb

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MAIL ROOM JUN 9 1921 U.S. PATENT OFFICE

SUPPLEMENTAL OATH

JUN 9 1921

State of New York }
County of New York } ss.

HAROLD D. ARNOLD, whose application for Letters Patent for an improvement in Vacuum Tube Circuits, Serial No. 425,259, was filed in the United States Patent Office on or about the 11th day of November, 1920, being duly sworn, deposes and says that the subject matter of claim 15 of the amendment filed April 2, 1921 was part of his invention, was invented before he filed his original application, of which the above identified application is a division, for such invention, was not known or used before his invention, was not patented or described in a printed publication in any country more than two years before his application, was not patented in a foreign country on an application filed by his legal representatives or assigns more than twelve months before his application, was not in public use or on sale in this country for more than two years before the date of his application, and has not been abandoned.

Harold D. Arnold

Sworn to and subscribed before me this 7 day of June, 1921.

Notary Public.

NOTARY PUBLIC, Queens County
Queens County Clerk's No. 1176
Certificate filed in New York County
Clerk's No. 176 Register's No. 7268
Commission Expires March 30, 1922

HAW:CK

910

Case 18-i

PAPER NO. 9
AMENDMENT C

(Q.78)

MAIL ROOM DEC 1921 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 712

30

In re application of

HAROLD D. ARNOLD

Serial No. 423,259

Filed November 11, 1920

Subject

VACUUM TUBE CIRCUITS

C

Allowed June 29-1921

PATENT OFFICE DEC 9 1921

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir;

Please amend the above entitled application as follows:

Page 2, after line 17, insert the following paragraph:

C1 This type of connection is also useful for connecting circuits of various kinds either with the input terminals or the output terminals of a vacuum tube.

Page 2, line 27, after the period, insert This application is a continuation in part of my application Serial No. 247,422, filed July 30, 1918, now patent No. 1,329,285, dated January 27, 1920.

C2

REMARKS.

It is believed that the above amendment to the statement of invention overcomes the Examiner's objections to the amendment presented November 14, 1921.

Claim 15 is readable not only on applicant's patent 1,114,865, cited in the Office Action of February 2, 1921, but also on patent No. 1,329,285. Since applicant has had a continuous disclosure of this subject matter in the Office

423259-26

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(Serial No. 423,259)

since May 16, 1914, it is thought proper to term this application a continuation in part of the last mentioned patent which itself refers back to an application filed May 28, 1914. The above patents show a vacuum tube connected by means of the coupling set forth in claim 15, in one case to a receiver and in the other case to a line transformer and it is believed to be unnecessary to make any additional showing in this application. It is believed that this amendment can properly be admitted under the Provisions of Rule 78.

Respectfully

HAROLD D. ARNOLD

By Otto J. Shugue
Attorney

ENTRY RECOMMENDED
UNDER RULE 78

A. O. Bainum
EXAMINER

463 West Street
New York, Dec 7., 1921

Entry Approved

DEC 13 1921

Thomas E. Robertson
Commissioner of Patents

HAW:E

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PLAINTIFF S' EXHIBIT No. 61 912

NUMBER (Series of 1913), 27175 — 1919 — (EXT'S BOOK) 283-8-9

DIV. 16 — PATENT No. 1448550

Name Harold D. Arnold, Assor to Western Electric Company Incorporated, of New York, N. Y., a corp of New York — MAR 13

of Maplewood

County of

State of New Jersey

Invention Thermionic Amplifier Circuits

PARTS OF APPLICATION FILED.

ORIGINAL		RENEWED	
Petition	Feb 3, 1919		, 191
Affidavit	, 1919		, 191
Specification	, 1919		, 191
Drawing	, 1919		, 191
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Appl. filed complete	Feb 3, 1919		, 191
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Examined and Passed for Issue	Sept 6, 1922		, 191
Exr. Div.	16	Exr. Div.	
Notice of Allowance	Sept 7 1922 By Commissioner.		, 191 By Commissioner.
Final Fee Cash	$20 Feb 15, 1923		, 191
" " Cert.	, 191	MAR 13 1923	, 191
			, 191

Patented

Attorney DeWitt, Fancher and John G. Rabenstein, Jr. New York, N.Y. 463 West Street

Associate Attorney W. C. Beattie C. L. Sprague, 463 West St. New York, N. Y.

(No. of Claims Allowed (2)) Print Claim in O. G. (Cl 179-171)

Title as Allowed Thermionic Amplifier Circuits

Address

The invention relates to repeater circuits wherein an electron-discharge device is employed for receiving comparatively weak incoming impulses and for transmitting them in the same form or in a modified form but with amplified energy. Such an amplifier which has a cathode, an anode and a control member usually in the form of a grid electrode, has a very high impedance between control member and cathode which are the usual input electrodes. This impedance is of the order of 25,000 ohms or more being in the nature of a space discharge path between electrodes in a vacuum. Preferably the vacuum is as perfect as practicable, substantially no positive ionization taking place during the operation of the device. In case a source of potential is employed for making the potential of the grid always negative, the input circuit impedance is of the order of infinity, for no electrons can flow from the filament to an electrode which is negative, so that no current flow takes place between cathode and grid even though the latter does respond to the incoming potential variations.

An object of the present invention is to modify the effect of this high input impedance so that it may have any desired finite value.

This is accomplished by connecting the incoming line to the repeater through a transformer, the secondary coil of which is shunted by a high impedance preferably a resistance of the order of 500,000 ohms and may, for instance, range from approximately 100,000 ohms to 1,000,000 ohms. This resistance is also in shunt to

the input electrodes. The impedance between the input electrodes may be made much higher than 500,000 ohms by a battery or other source which maintains the grid negative. The impedance at the secondary side of the transformer is practically that of the 500,000 ohm resistance, as the higher impedance path between the input electrodes takes practically no current or at least a negligible current.

By this arrangement the same amplification can be secured with amplifier tubes having different input impedances, and it is feasible to substitute one such tube for another in a given circuit arrangement.

More uniform amplification may also be secured by this arrangement with varying input power. In the use of amplifier circuits heretofore designed it has been found that there is a tendency for small input voltages to be amplified proportionately more than large input voltages, for the reason that the input impedance of the tube is greater for small voltages than for large voltages, especially when no means is employed for maintaining the control electrode negative with respect to the cathode. By the use of a shunt path of constant resistance less than that between the input electrodes this tendency is substantially eliminated.

Aside from the above mentioned advantages of using the shunt impedance, it has the advantage, regardless of the function of the vacuum tube or of the circuit in which it is connected, of preventing singing of the repeater in case the output and input circuits thereof are coupled either designedly by an inductive coupling for instance, or accidentally by reason of the proximity

of the input and output leads of the repeater.

A further advantage inherent in the use of a high impedance shunt between the line and the repeater is that it is possible to employ vacuum tubes having different but high impedances in the same circuit without substantially affecting the impedance of the circuit as seen from the primary side of the transformer.

Eqv. Amdt. This application is a continuation in part of application, Serial No. 59,210, filed November 2, 1915, and of application Serial No. 48,875, filed September 3, 1915.

For further details of the invention, reference may be made to the drawings in which the single figure illustrates diagrammatically a repeater circuit embodying the invention.

Referring in detail to the figure, the incoming line 1 is adapted to be traversed by weak incoming impulses which are to be amplified by the amplifier 2, and to be sent out in amplified form upon the line 3. Preferably there is employed the battery 4 or other source which maintains the grid negative with respect to the cathode, in which case the input impedance of the repeater is practically infinite, as described above. The line 1 is connected to the input electrodes of the repeater which, in this case, are the grid and cathode electrodes, by the repeating coil or transformer 5. In shunt to the secondary of the repeating coil 5 and also in shunt to the input electrodes is the impedance 6, which may be non-inductive as shown and in the form of a resistance of the order of 500,000 ohms. This resistance may assume any desired form; viz, it may be a wire resistance, a lavite

resistance, or a piece of paper treated with india ink and sealed in a glass tube. The battery 7 in the output circuit of the repeater supplies space current through the choke coil 8 and between cathode 9 and anode 10. If desired, the output circuit of the repeater may be coupled to the line 5' by the repeating coil 11, as shown.

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WHAT IS CLAIMED IS:

Issue

1. The combination of a vacuum discharge repeater of the three-electrode type, an inductive coil connectively connected to the input electrodes of said repeater and a conductive impedance in shunt to said coil.

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" B
Per A
Sub A
" A
" A
Insert A

Claim 2

2. The combination of an incoming line, a repeater having input electrodes, a transformer coupling said line to said repeater, and a conductive impedance in shunt to one of the coils of said transformer.

3. The combination of an incoming line, a repeater having input electrodes, a transformer coupling said line to said repeater, a conductive impedance in shunt to the secondary coil of said transformer.

" A
" A
Insert A2
" A

4. The combination of a line, a vacuum tube amplifier connected thereto, said amplifier having input terminals of the three-electrode type and a high resistance connected to said terminals.

" B
Insert A3

5. The combination of a line, a vacuum tube amplifier connected thereto, said amplifier having grid and cathode electrodes, and a resistance of the order of 100,000 ohms forming a by-path between said electrodes.

Insert A4

6. The combination of a vacuum tube amplifier having grid and cathode electrodes, means for making the potential of said grid negative with respect to said cathode, and a high resistance by-path for said electrodes.

7. The combination of a line, a vacuum tube amplifier, a transformer for connecting said line to said amplifier, and a by-path between said line and said amplifier and having an impedance of the order of 500,000 ohms.

Insert a5

8. The combination of an incoming line, a repeater having a cathode and an anode, means for supplying a space current between said electrodes, a member for controlling said space current, and means between said line and said repeater for making the impedance of the repeater as seen from said line, substantially of a constant value.

Insert a6

9. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said electrodes, a grid electrode for controlling said space current, means for making said grid negative with respect to said cathode, and means between said line and the input electrodes for making the impedance of said amplifier as seen from said line, substantially of a constant value.

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10. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said electrodes, a grid electrode for controlling said space current, means for making said grid negative with respect to said cathode, a transformer for connecting said line to said amplifier, and a high resistance in shunt to the secondary winding of said transformer and to said grid and cathode

OK

electrodes for making the impedance of said amplifier as seen from said line, substantially of a constant value.

Per A

11. The combination of a line, an amplifier in circuit therewith having an input impedance at least as high as 10,000 ohms, and a shunt between said line and said amplifier having an impedance of an order lower than that of the input impedance of said amplifier.

12. ~~10.~~ The combination of a line, an amplifier in circuit therewith having an input impedance at least as high as 100,000 ohms, and a shunt between said line and said amplifier having an impedance of an order lower than that of the input impedance of said amplifier.

13. ~~11.~~ The combination of a line, an amplifier in circuit therewith having an input impedance which is practically infinite, and a shunt between said line and said amplifier having an impedance of the order of 500,000 ohms.

Insert A7

WEB:QA

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IN WITNESS WHEREOF, I hereunto subscribe my name this 15th day of January, A. D. 1919.

Harold D. Arnold

OATH

State of New York }
County of New York } ss.

HAROLD DeFOREST ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Maplewood, in the County of Essex and State of New Jersey, and that he verily believes himself to be the original, first, and sole inventor of the improvement in THERMIONIC AMPLIFIER CIRCUITS, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to the applications of which this is a continuation, or in public use or on sale in the United States for more than two years prior to the applications of which this is a continuation; that the said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to the applications of which this is a continuation; and that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the United States.

Harold D. Arnold

Sworn to and subscribed before me this 15th day of January, 1919.

Notary Public

921

Div. 16 Room 112 Paper No 3

"The Commissioner of Patents, Washington, D. C." and not any official by name. JLP:LBG

Applications should give date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON July 10, 1919

U. S. PATENT OFFICE JUL 10 1919 MAILED

Mr. John C. Roberts,

920 Broadway,

New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

Harold D. Arnold, Ser. #274,950, filed Feb. 3, 1919.

Thermionic Amplifier Circuits.

James T. Hewton

Commissioner of Patents.

This application has been examined.

The specification is indefinite as to the frequency at which the various values of impedance stated are effective. Inasmuch as impedance is more generic in meaning than a simple non-inductive resistance, it fails to convey the proper significance unless the factor of frequency is stated.

Claims 7 to 15 inclusive are objected to for the above reasons in that the claims purport to describe something other than non-inductive resistance and yet fail to specify a term, namely frequency, which is necessary in order to give some significance to the word impedance.

The following references are made of record:

STONE ET AL,	884,110, April 5, 1908, 250-27;
COLPITTS,	1,129,959, March 2, 1915, 179-171;
LANGMUIR,	1,225,496, Apr. 24, 1917, 179-171;
COLPITTS, Reissue	14,380, Oct. 23, 1917, 179-171.

Claims 1 to 15 inclusive are rejected on Colpitts reissued patent, attention being called to Fig. 2 of Colpitts, wherein the resistance 26 shunts the secondary coil 14 of transformer 15. Although the amplifier shown is not a simple form, it amplifies the input signal.

Claims 1, 2 and 3 are rejected on Stone et al, cited.

Claims 4, 5, 6, 8, 9, 11, 12 and 13 are rejected on Langmuir, cited, attention being called to resistance 4.

Claim 1 is rejected on Colpitts 1,129,959, wherein the inductive coil 25 or 26 is conductively connected to the electrodes 11, 23, and the impedance of the output circuit of the tube 3 is in shunt of these coils.

Claims 11 and 13 are not considered allowable over claim 11, differing merely in degree.

Examiner, Div. 16.

922

PAPER NO. 6

ART UNIT a

Office Ref.

MAIL ROOM JUN 1920 PATENT OFFICE

UNITED STATES PATENT OFFICE

Division 16 Room 112

001-1

In re application of

HAROLD D. ARNOLD

Serial No. 274,750

Filed February 3, 1919

Subject.

Thermionic Amplifier Circuits

PATENT OFFICE JUN 30 1920 RECEIVED

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of July 10, 1919, please amend the above-entitled application as follows:

Claim 1, line 4, and claims 2 and 3, line 3, cancel "an" and substitute therefor --a conductive--.

Claim 2, line 2, after the word "repeater", insert --having input electrodes--; line 5, after the comma, insert --one coil of said transformer being conductively connected to said electrodes--.

Claim 3, line 2, after "repeater" insert --having input electrodes--; line 3, after the comma, insert --the secondary coil of said transformer being conductively connected to said electrodes--; same line, change "the" to --said--; line 4, cancel "of said transformer".

Claim 4, line 3, after the comma, insert --means for applying a steady difference of potential between said input terminals--.

Claim 5, line 3, after the comma, insert --means for applying a steady difference of potential between said electrodes--.

Claim 7, line 3, cancel "and"; line 5, change the

Page Tightly Bound

(Serial No. 274,750)

period to a comma and add --and means for maintaining the impedance of said amplifier greater than that of said by-path--.

Claim 8, line 5, after the comma, insert --means for applying a steady difference of potential between said cathode and said control member--.

Cancel claim 11.

Renumber claims 12 and 13 as 11 and 12, and add the following:

--13. An incoming line, a thermionic amplifier, means comprising a symmetrically conducting aperiodic circuit between said line and said amplifier whereby the currents in said line are adapted to be accurately reproduced in augmented form.--

--14. The combination of a symmetrically conducting aperiodic circuit, a vacuum tube having input terminals and an output circuit, and connections between said aperiodic circuit and said input terminals.--

REMARKS

Reconsideration of the objection to claims 7 to 13 on the ground that the word "impedance" is improperly used, is respectfully requested. "Impedance" is a generic word which includes within its meaning resistance and reactance. If it is desired to substitute an inductance for the resistance 6 in the drawing, it is a simple matter to calculate the proper value for the inductance which will give the desired impedance for

the frequency to be used. It is, moreover, possible to design a network of reactances which will have a constant impedance throughout a wide range of frequencies. An example of such a network is the filter disclosed in Campbell patent No. 1,227,114, dated May 22, 1917. This filter is designed to have a constant impedance throughout substantially the entire range of the filter. Theoretically, moreover, a network could be designed which would be of constant impedance throughout an infinite number of frequencies. The applicant has disclosed one form of impedance which remains constant throughout the range of frequencies to be employed, and it is believed that this amounts to a sufficient disclosure to warrant the claims now in the case.

An affidavit is filed herewith carrying the date of applicant's invention back of the filing dates of the Colpitts and Langmuir patents of record. The date of invention is earlier also than the filing date of Langmuir patent No. 1,297,183, dated March 1, 1919, original filing date October 29, 1915, which has certain features in common with applicant's circuit.

Claims 1, 2, and 3 have been amended to distinguish over the Stone patent of record.

Claim 11 has been cancelled, but original claims 12 and 13 have been retained. Claim 12, formerly 13, differs from claim 11, formerly 12, in the limitation that the input impedance of the amplifier is substantially infinite. The impedance is made infinite by applying a negative potential to the grid, and it is believed that this limitation renders the claims patentably different.

925

Serial No. 274,750)

New claims 13 and 14 were allowed as presented by amendment of August 22, 1919 in the application of B. W. Kendall, Serial No. 149,782, filed February 20, 1917. It has been discovered that the applicant is the prior inventor of the subject-matter of these claims, rather than Mr. Kendall, and it is believed that the claims are allowable in this application.

Favorable consideration and allowance of the application as amended is respectfully requested.

Respectfully,

HAROLD D. ARNOLD

By _____
Attorney

463 West Street,
New York, N.Y., June 26, 1920.

HAW:BM

-4-

4/14

926

#6

In re application of

HAROLD D. ARNOLD - Filed February 3, 1919 - Serial No. 274,750 -
Subject - THERMIONIC AMPLIFIER CIRCUITS.

O A T H

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.

Patent Office
JUN 30 1920

HAROLD D. ARNOLD being duly sworn, deposes and says:

That he is the applicant in the above-named application; that the circuit shown on the attached blue-print marked ES-05922 represents a vacuum tube amplifier circuit which was set up and tested under his direction prior to October 29, 1915; that a resistance of 240,000 ohms was connected in shunt to the secondary of the input transformer and to the input electrodes of the vacuum tube; that the circuit with said resistance in circuit was tested with currents of a frequency within the voice range; that said currents were amplified in a satisfactory manner; that said blue print is a copy of a drawing which was made prior to October 29, 1915;

That he does not know and does not believe that the invention has been in public use or on sale in this country or patented or described in any printed publication in this or any foreign country for more than two years prior to his original application, of which this is a continuation; and that he has never abandoned the invention.

Harold D. Arnold

Sworn to and subscribed before me this 26th day of June, 1920

Walter Winston
Notary Public.

NEW YORK COUNTY
COUNTY CLERK'S NO. 1131
MY COMMISSION EXPIRES MARCH 30, 1921

APPROVED
Gen'l Dept.
Jun 29 1920
R. A. Hostetter

1927

Sketch No. ES 93922

AUDION
-26-
PLATINUM - BARIUM

INPUT vs OUTPUT

INPUT vs EFFICIENCY

COMPARISON OF "C" BATTERY AND SHUNT RESISTANCE OF 240,000 OHMS

IN BOTH CASES

FILAMENT
2.4 VOLTS
0.25 AMPERES

SPACE
2ⁿ VOLTS
280 - 660 TO 1 AMP

EXTERNAL RESISTANCE
30,000 OHMS

OUTPUT IN MICRO WATTS

7000
6000
5000
4000
3000
2000
1000

OUTPUT / INPUT EFFICIENCY

900
800
700
600
500
400
300
200
100

STRAIGHT CIRCUIT

"C" BATTERY = 2.4 VOLTS

SHUNT RESISTANCE 240000Ω

STRAIGHT CIRCUIT

THE CIRCUIT

"C" Battery

Shunt

Phone

"C" BATTERY = 2.4 VOLTS

SHUNT RESISTANCE = 240,000

INPUT in R.F. VOLTS A.C.

0.5 1.0 1.5 2.0 2.5 3.0 3.5

928

Paper No 7

"The Commissioner of Patents, Washington, D. C.," and not any official by name.

Application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Oct. 13, 1920

Mr. John C. Roberts,
403 West St.,
New York, N. Y.

U.S. PATENT OFFICE OCT 13 1920 MAILED

Please find below a communication from the EXAMINER in charge of the application of

H. D. Arnold, Ser. #274,750, filed Feb. 3, 1919.

Thermionic Amplifier Circuits.

ROBT. F. WHITEHEAD
Commissioner of Patents.

This action is responsive to amendment filed June 29, 1920.

Claims 1 to 5, 8 and 11 are rejected as failing to distinguish patentably from

LINDRIDGE, 1,047,956, Dec. 24, 1912, 179-171 Gas.

It will be noted that choke coil 11 of the reference constitutes a "conductive impedance"; and, furthermore, may be made of any magnitude even as high as 100,000 ohms. Regarding claims 4 and 5, the high resistance is read on the unilateral conductive element 2.

Claims 13 and 14 are rejected as misdescriptive in calling for "an aperiodic circuit". It is thought there is sufficient capacitance between the individual coils of the secondary and inductance of the whole to preclude the possibility of claiming a pure aperiodic circuit.

All other claims appear allowable.

Exr., Div. 16.

HAB.

61/17

(29)

UNITED STATES PATENT OFFICE

Division 16 Room 112

PAPER NO 9
AMENDMENT B

In re application of

HAROLD D. ARNOLD

Serial No. 274,750

Filed February 5, 1919

Subject.

Thermionic Amplifier Circuits

PATENT OFFICE
OCT 11 1921

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office Action of October 15, 1920, please amend the above entitled application as follows:

Claim 1, line 2, cancel "having input electrodes" and substitute therefor --of the three-electrode type--; line 3, change "said" to --the--; same line, after "electrodes" insert --of said repeater--.

Rewrite claims 2 and 3 as follows:

2. The combination of an incoming line, an electric discharge repeater of the three-electrode type, a transformer coupling said line to said repeater, one coil of said transformer being conductively connected to the input electrodes of said repeater, and a conductive impedance in shunt to one of the coils of said transformer.

3. The combination of an incoming line, an electric discharge repeater of the three-electrode type, a transformer coupling said line to said repeater, the secondary coil of said transformer being conductively connected to the input electrodes of said repeater, and a conductive impedance in shunt to said secondary coil.

Cl 4 Feb 21/18

(Serial No. 274,760)

Claim 4, line 2, after "amplifier" insert --of the three-electrode type--.

Cancel claims 13 and 14.

REMARKS

Claims 1, 2, 3 and 4, as amended, and claims 5, 6 and 11, as previously worded, are thought to clearly distinguish from the Lindridge patent cited in the last Office Action. Claims 1 to 5 and 8 are limited to a repeater of the three-electrode or so-called audion type. The discharge device of Lindridge which is alleged to act as a repeater is of the two-electrode type and incoming potentials are impressed across the ends of the filament. Although Lindridge shows six tubes with their filaments connected in series, it is not believed that the input impedance of the whole device is more than thirty or forty ohms, since in electron discharge devices of which the applicant is aware, the resistance of individual filaments is of the order of six ohms. The impedance 11 of Lindridge, if as stated by the Examiner may have an impedance of 100,000 ohms at some frequency in the voice range, could not have the functions of applicant's resistance 6. Claim 8 is further limited to a condition where changing from one tube to another of a different impedance does not change the impedance of the repeater as seen from the line. This is not true in the low impedance repeater of Lindridge. Claim 11 specifically states that the input impedance of the amplifier is 100,000 ohms or more. In view of the fact

that each of these claims contains material structural differences over Lisdridge and that these differences contribute to a new result, it is believed that the Examiner will see his way clear to allow these claims.

In view of the rejection of claims 13 and 14 as misdescriptive, these claims have been cancelled and will be reinserted in the application of B. W. Kendall, Serial No. 145,782, filed February 20, 1917. These claims were inserted in this case for the reason that the applicant was in doubt as to whether they could be properly based on the disclosure in this case. The applicant now agrees, however, with the Examiner's position that they are misdescriptive of his arrangement.

Respectfully

HAROLD D. ARNOLD

By Chas. Shaw
Attorney

463 West Street

New York, October 7, 1921

AW:E

Div. 16 Room 113 HRB:EBG

Paper No. 10

Address only "The Commissioner of Patents, Washington, D.C." and not any official by name.

All communications relating to this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

Sept. 7, 1922
EXAMINER'S AMENDMENT

Mr. John Q. Roberts,
465 West St.,
New York, N. Y.

SEP 7 1922

Please find below a communication from the EXAMINER in charge of the application of

H. D. Arnold, Ser. 274,780, Filed Feb. 8, 1919.
Thermionic Amplifier Circuits.

THOS. E. ROBERTSON, *Commissioner of Patents.*

In accordance with the provisions of Order No. 2308, dated March 12, 1917, which reads in part as follows:

> Obvious informalities in the application may be corrected by the examiner, but said correction must be in the form of an amendment, approved by the Principal Examiner in writing, placed in the file, and made a part of the record. The changes specified in the amendment will be entered by the clerk in the regular way.

the changes, hereinafter specified, are made by the examiner in the application above identified.

Should these changes not be satisfactory to the applicant, appropriate amendment may be prepared under the provisions of Rule 78, provided the specification has not been printed.

The application has been amended as follows:

Page 4, line 9, in part is inserted after "continuation".

A 10/1

Exr., Div. 16. 6/21

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PAGE

933

PLAINTIFF'S EXHIBIT No. 62

NUMBER (Series of 1925). 406695

1920

CAVE'S BOOK 174-8-9

DIV. 16

PATENT No. 1465382

Name Harold D. Arnold, Assgr. to Western Electric Company Incorporated, of New York, N. Y., a corp. of New York

of Maplewood

County of

State of New Jersey

Invention Vacuum Tube Amplifiers

	ORIGINAL		REISSUED	
Petition	Aug 28	1920	17/14	192
Affidavit	" "	1920	" "	192
Specification	" "	1920	11½	192
Drawing	" "	192	7	192
Photo Copy	Aug 1	192 2	2½	192
First Fee Cash	$15 Aug 28	1920	2½	192
" " Cert.		192		192
Appl. filed complete	Aug 28	192		192
				192
Examined and Passed for Issue	Mar 17	1923		192
O. H. Baxter Ex. Div.	46			Ex. Div.
Notice of Allowance	Mar. 28, 1924			192 by Commissioner
Final Fee Cash	$20 July 21	1923		192
" " Cert.		193	MAR 11 1929	192
Patented				192

Attorney De Witt C. Tanner & John G. Roberts 463 Fulton Ave. New York N.Y.

Associate Attorney ~~H. C. Baxter~~ 463 Fulton Ave. New York N.Y.

J. C. R. Palmer

(No. of Claims Allowed 11) Print Claim 1 in O. G. (Cl 179-171)

Title as Allowed Vacuum Tube Amplifier

Address

1931.

This invention relates to vacuum tube amplifiers, and more particularly to arrangements for supplying space current thereto.

An object of this invention is to provide means whereby a plurality of vacuum tubes to be used as repeaters or amplifiers may be supplied with space current from a single source, but in such a manner that current changes in one tube due to signals being repeated cannot be impressed on another tube through said source.

With the arrangement shown herein, a single source of space current is used to energize both tubes of a two stage amplifier, and in the branches of the circuit therefore are interposed filters of series inductance and shunt capacity to prevent alternating current from being bypassed there-through.

The invention described and claimed herein is divided out of my applications, Serial No. 48,878, filed September 5, 1915, and Serial No. 285,857, filed March 28, 1919.

For further details, reference may be made to the accompanying drawings in which the single figure illustrates diagrammatically a two stage amplifier embodying the invention.

Referring to the drawing by reference numerals, the amplifier set comprises a tandem arrangement of two vacuum tubes 10 and 11 each having cathode 12, a grid or control electrode 13, and an anode 14. The cathodes 12 are maintained in a condition of thermionic activity by currents from sources 15.

The input circuit of tube 10 comprises terminals 16, 17, adapted to be connected to a suitable source of electric impulses to be repeated, a resistance 18 bridged across the

62/b

input electrodes, and a battery 19 adapted to maintain the grid electrode at a negative potential with respect to the cathode. Current between the anode and cathode is supplied from battery or other suitable source 20, the current passing in series through the inductance 21 and the transformer primary 22. A shunt condenser 23 provides a path for the alternating current.

The transformer secondary 24 has connected across its terminals a resistance 25, one end of which is connected to the cathode of tube 11. Connection from resistance 25 to the grid of tube 11 comprises the movable contact 26 and the battery 27, the function of the latter being to provide the necessary negative potential on the grid.

Direct current is supplied to the tube 11 from source 20, through inductances 28 and 29, and grounds 30 and 31. Condenser 32 is shunted across the direct current circuit. The output circuit for alternating current comprises the condenser 33 and the primary 34 of a transformer, the secondary 35 of which is adapted to be connected through terminals 36 and 37 to any suitable receiving circuit.

In operation, the signals or other impulses, which are repeated and amplified by the tube 10, are impressed on the resistance 25 by currents induced in the secondary coil 24. The input electrodes of the second tube are shunt to an adjustable part of the resistance 25, and therefore any desired proportionate part of the potential drop across the resistance may be impressed between the input electrodes, with the result that the ratio of amplification may be varied between a predetermined maximum and zero.

The series inductances 21 and 28 and the shunt condensers 23 and 32 serve to prevent potential variations

from the source or from either tube from being impressed through the supply circuit on the other tube.

While I have shown and described one embodiment of the invention, it is obvious that it may assume any desired form within the scope of the appended claims.

R.A.W.

WHAT IS CLAIMED IS:

1. In combination, a plurality of vacuum tube repeaters, and a common source of space current for said repeaters, the circuit between one of said repeaters and said source comprising series inductance, and a path comprising bridged across said circuit between said source and said repeater capacity.

2. In combination, a plurality of vacuum tube repeaters, and a common source of space current for said repeaters, the circuit between each of said repeaters and said source comprising series inductance, and a path comprising capacity.

3. In combination, a plurality of vacuum tube repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from one of said repeaters from flowing in the portion of the space current circuit common to said repeaters.

4. In combination, a plurality of vacuum tube repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from flowing from each said repeaters to the others of said repeaters through the portion of the space current circuit common to all.

5. In combination, a source of current, branched circuits therefrom to a plurality of vacuum tube repeaters for supplying space current thereto, and a wave filter in each of said branches.

6. The combination in an amplifying system of a plurality of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid

62/5

circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers, and a filter connected between said source and said plate circuits for eliminating the effect in said plate circuits of potential variations in said source.

7. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers in succession from the last to the first, and a filter connected between said source and the plate circuit of the last of said amplifiers for eliminating the effect in said plate circuits of potential variations in said source.

8. In a multi-stage amplifier, a plurality of vacuum tubes connected in tandem, a common source of space current for said tubes, and a filter comprising series inductance and shunt capacity between one of said tubes and said source.

9. In a multi-stage amplifier, a plurality of vacuum tubes connected in tandem, a common source of space current for said tubes, and a filter comprising series inductance and shunt capacity between each of said tubes and said source.

10. In combination, a plurality of vacuum tube translating devices, a common source of potential for said vacuum tubes, a circuit connecting each of said tubes to said source containing series inductance and shunt capacity.

11. In combination, a plurality of vacuum tube translating devices, a common source of current for

and a path comprising capacity bridged across connecting energizing said tubes, each of the circuits/said tubes to said source ~~comprising shunt capacity~~.

12. In combination, a plurality of vacuum tube translating devices, a common source of current for energizing said tubes, each of the circuits connecting said tubes to said source comprising series inductance.

13. In combination, a plurality of vacuum tube translating devices, a common source of space current for said tube, each of the circuits connecting said tubes to said source comprising series impedance and shunt capacity.

14. In combination, a plurality of vacuum tube translating devices, a common source of space current for said tube, a filter comprising and inductance element and a capacity element between each of said tubes and said source, one of said elements being in shunt and one in series.

9 12 ~~15~~. In combination a plurality of vacuum tube translating devices, a common source of current for energizing said vacuum tubes, each of the circuits between said tubes and said source comprising series impedance, and a shunt effectively in shunt to said source capacity for preventing interference between said tubes.

Insert A' Feb 10-11

HAN:JV
LAB/

910

In Witness Whereof, I hereunto subscribe my name
this 25th day of August A. D., 1920

Harold De Forest Arnold

OATH.

State of New York }
County of New York } ss.

HAROLD DE FOREST ARNOLD the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Maplewood in the County of Essex and State of New Jersey and that he verily believes himself to be the original, first, and sole inventor of the improvement in VACUUM TUBE AMPLIFIERS described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that the said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the United States, except as follows:

Harold De Forest Arnold

Sworn to and subscribed before me
this 25th day of August 1920

Jacob H. Gilbert
Notary Public.

911

Case 36-A
PAPER No 2
AMENDMENT a
10 ath

JAN 15 1921 PATENTOFF

UNITED STATES PATENT OFFICE.

Division Room

1207

In re application of

HAROLD DEFOREST ARNOLD

Serial No. 406,695

Filed August 28, 1920

Subject.

Vacuum Tube Amplifier

THE COMMISSIONER OF PATENTS,
Washington, D. C.

JAN 17 1921

Sir:

Please amend the above entitled application as follows : -

Add the following claims : -

a'

10. ~~12.~~ ~~16.~~ The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers in succession from the last to the first of said amplifiers, and filter connections between successive amplifiers of the series.

O.K

11 ~~14.~~ ~~17.~~ The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the

O.K

FORM No. 10
RECLASSIFICATION TO
PATENT OFFICE
3 PRINTED

plate circuits of all of said amplifiers, and filter connections between successive amplifiers of the series.--

R E M A R K S.

A new oath is filed herewith which is appropriate to a divisional application.

New claims 16 and 17 added by this amendment, are believed to be allowable along with the claims already in the case. These claims and original claims 6 and 7 were copied from Canadian patent No. 196,389, issued January 20, 1920.

Respectfully,

HAROLD DEFOREST ARNOLD

By W. G. Beatty
Attorney

463 West Street.

New York, January 14, 1921.

HAW:SI

MAIL ROOM
JAN 15 1921

#2

UNITED STATES PATENT OFFICE

In re Application of

HAROLD DEFOREST ARNOLD

Serial No. 406,695

Filed August 28, 1920

Vacuum Tube Amplifiers

O A T H

State of New York)
) ss.
County of New York)

HAROLD DEFOREST ARNOLD, the applicant in the above entitled application, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Maplewood, in the County of Essex and State of New Jersey, and that he verily believes himself to be the original, first and sole inventor of the improvement in VACUUM TUBE AMPLIFIERS, described and claimed in the above entitled application; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to the application of which this is a division, or in public use or on sale in the United States for more than two years prior to the application of which this is a division; that said invention has not been patented in any country foreign to the

United States on an application filed by him or his legal representatives or assigns more than twelve months prior to the application of which this is a division; that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the Unites States prior to the filing date of the application of which this is a division; that the subject matter claimed herein was a part of his invention disclosed in the application of which this is a division, was invented before he filed said application and has not been abandoned.

Harold E. Hurst Arnold

Sworn to and subscribed before me

this 14 day of January, 1921.

Jack H. Gilbert

Notary Public

NOTARY PUBLIC
New York Co. Clerk's No. 491
Commission Expires March 30, 1

Div. 16 Room 112 L&C 3

Address only
"The Commissioner of Patents,
Washington, D. C."
and not any official by name.

When writing give the art unit number, date of this letter, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON April 6, 1921

U. S. PATENT OFFICE
APR 6 1921
MAILED

Mr. John G. Roberts,
463 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of
H. D. Arnold, Ser. #406,695, filed Aug. 28, 1920.
Vacuum Tube Amplifiers.

THOS. E. ROBERTSON
Commissioner of Patents

This application, as amended, has been examined.

Page 2, line 4, correct invention.

Page 4, line 4, correct obvious.

Record is made of

SCHLOEMILCH ET AL, 1,087,892, Feb. 14, 1914, 250-8;
NICOLSON, 1,255,211, Feb. 8, 1918, 179-171;
MARCONI (BR) 13,248/1914, 1 sheet, 250-27;
VON LIEBEN ET AL (FR) addition 13,726/1911, 1 sheet, 250-27.

All claims are rejected as defining nothing patentable over the BRITISH patent, attention being called to Fig. 4 thereof, which illustrates a plurality of tubes effectively in cascade, the plate circuits of which are fed by common source B. It is to be noted that there is an inductance shunted by a condenser adjacent said source in each output circuit.

In claims 1, 2, 8 to 15, "series inductance and shunt capacity" is thought to be vague and indefinite inasmuch as it is not apparent whether "shunt" refers to the previously recited "circuit" or to the "said inductance", an example of the latter being shown by reference as pointed out.

Claim 14 is further rejected as being broader than

Ser. #406,695 - #2.

the disclosed invention for the reason that "shunt" and "series" would ordinarily refer to the preceding terms, "inductance" and "capacity", in the stated order; the respective relation of which is neither illustrated nor described.

O D Baucom

Exr., Div. 16.

HHB

947

MAIL ROOM MAR 22 1922 PATENT OFFICE

Case 36-A
PAPER No 5
AMENDMENT B

UNITED STATES PATENT OFFICE.

Division 16 Room 112

121

In re application of
HAROLD D. ARNOLD,

Serial No. 406,695.

Filed August 28, 1920.

Subject.
VACUUM TUBE AMPLIFIERS.

PATENT OFFICE
MAR 23 1922

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of April 6, 1921, amend as follows:

Page 2, line 4, correct the spelling of "invention".

Page 4, line 4, correct the spelling of "obvious".

Claim 1, line 2, insert a comma after "repeaters"; cancel "and";
line 4, insert a comma after "inductance"; cancel "shunt" and substitute --a path comprising--;
line 5, after "capacity" insert --bridged across said circuit between said source and said repeater--.

Claim 2, line 2, insert a comma after "repeaters"; cancel "and";
line 4, insert a comma after "inductance"; cancel "shunt" and substitute --a path comprising--;
line 5, after "capacity" insert --bridged across each of said circuits between said source and the respective repeaters--.

Serial No. 406,695---2.

Claim 5, line 3, correct the spelling of "for".

Claim 8, line 3, after the comma insert --branch circuits connecting said source and said tubes,--;

line 4, after "inductance" insert -- in one of said circuits--;

cancel "shunt" and substitute --a path containing--;

after "capacity" insert --bridged across the circuit--.

Claim 9, line 3, after the comma insert --branch circuits connecting said source and said tubes--;

line 4, after "inductance" insert --in each of said circuits--;

cancel "shunt" and substitute --a path containing--;

after "capacity, insert--bridged across each of said circuits--.

Claim 10, line 2, after "devices" insert a comma;

line 4, cancel "shunt" and substitute --a path comprising--;

after "capacity" insert --bridged across each of said circuits--.

Claim 11, line 3, after the comma insert --and a path comprising capacity bridged across--;

line 4, cancel "comprising shunt capacity."

Cancel claims 12, 13 and 14, and renumber claims 15, 16, and 17, as 12, 13, and 14.

Claim 12, formerly 15, line 4, after "impedance" insert a comma;

cancel "shunt" and substitute --a--;

line 5, after "capacity" insert --effectively in shunt to said source--.

Serial No. 406,695---3.

REMARKS

Applicant is unable to see how the Marconi patent of record anticipated either in spirit or in terms any of the claims as originally presented, with the exception of claim 12, which has been cancelled. The remaining claims call for a filter in the branch circuits br for a series inductance and shunt capacity. Since in the Marconi disclosure the capacity and inductance are in the same relation in the circuit, it is not understood how one of them could be in series and one in shunt. In order to render the distinction clearer, however, certain of the claims have been amended to call for a path comprising capacity bridged across the circuit. This clearly is not shown in the Marconi patent. This patent, moreover, has no equivalent means, although a common source is used for energizing the tubes, and no means is provided for preventing reaction of one tube on the other through the common connections to the source of energy. In fact the alternating current in each of the tubes is required to pass either through the source G or through the circuit of the other tube. This is a result which it is an object of this invention to prevent.

It is believed that claims 3, 4, 5, 6, 7, 14, and 15, as originallyworded, and claims 1, 2, 8, 9, 10, 11, and 13, as amended, are clearly patentable over the Marconi patent or any other art of which applicant is aware, and their allowance is solicited.

Respectfully

HAROLD D. ARNOLD.

By Jos. K. Palmer
Attorney

463 West Street,
New York City March 21 1922.
HAW:UR

950

Case 36-A

PAPER NO 6
LETTER

MAIL ROOM JUL 12 1922 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 112

In re application of

HAROLD D. ARNOLD

Serial No. 406,695

Filed August 28, 1920

Subject.

VACUUM TUBE AMPLIFIERS

PATENT OFFICE JUL 13 1922

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Supplemental to amendment of March 22, 1922, applicant has noted the issuance of patent No. 1,419,797, dated June 13, 1922 to E. F. W. Alexanderson. Claims 3 and 4 of this patent are identical with claims 13 and 14 of this application. As pointed out in the amendment presenting claims 13 and 14, the claims were copied from Alexanderson's Canadian patent.

In view of the fact that applicant's effective filing date is nearly four years earlier than Alexanderson's filing date, it is requested that the claims be allowed to applicant either with or without the formality of an interference.

Respectfully,

HAROLD D. ARNOLD
By Jas. K. Lamar
Attorney

463 West Street,
New York, July 11, 1922.

HAW:AO

6348

2—010

INTERFERENCE.

Interference No. 47998 *Paper No.* 7

Name, Arnold, Harold DeForest.

Serial No. 406695.

Title, Vacuum Tube Amplifiers.

Filed, Aug. 28, 1920

Interference with E. F. W. Alexanderson

DECISIONS OF

Primary Examiner, _____ *Dated,* _____

Ex'r of Interferences, Favorable *Dated,* Nov 23/22

Board, _____ *Dated,* _____

Commissioner, _____ *Dated,* _____

REMARKS:

This should be placed in each application or patent involved in interference in addition to the interference letter by Primary Examiner.

6—020

952

Forwarded from 15 Div. to Examiner of Interferences. HHB:LBG- 213 Paper No. 8 [INTERFERENCE]

Aug. 5, 1922.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C.

Mr. John G. Roberts,
463 West 5t.,
New York, N. Y.

U.S. PATENT OFFICE
AUG 16 1922
MAILED

Please find below a copy of a communication from the Examiner concerning the

Harold D. Arnold, Ser. #406,695, filed Aug. 28, 1920; division of Ser. #285,857, filed Mar. 28, 1919; div. of Ser. #48,873, filed Sept. 3, 1915. Vacuum Tube Amplifiers.

Very respectfully,

Room No. 112

ADDRESS ONLY THE COMMISSIONER OF PATENTS WASHINGTON, D. C.

THOS. E. ROBERTSON
Commissioner of Patents.

47998

The case, above referred to, is adjudged to interfere with others, hereafter specified, and the question of priority will be determined in conformity with the Rules.

The statement demanded by Rule 110 must be sealed up and filed on or before SEP 18 1922 *with the subject of the invention, and name of party filing it, indorsed on the envelope. The subject-matter involved in the interference is*

1. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers in succession from the last to the first of said amplifiers, and filter connections between successive amplifiers of the series.

2. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers and filter connections between successive amplifiers of the series.

The interference involves your application above identified; and

A patent, No. 1,419,797, granted June 13, 1922, on application for Amplifying Systems, Serial No. 276,852, filed Feb. 15, 1919, by Ernst F. W. Alexanderson, whose postoffice address is General Electric Company, Schenectady,

Ser. #405,695 - 2.

New York, whose attorney is Albert G. Davis, of General Electric Company, Schenectady, N. Y., and whose assignee is General Electric Company, a corporation of New York.

The relation of the counts of the interference to the claims of the respective parties is as follows:

Counts:	Alexanderson:	Arnold:
1	3	13
2	4	14

Exr., Div. 16.

954

Div. 16 Room 112 [illegible] Paper No. 9

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Jan. 11, 1923

PATENT OFFICE JAN 11 1923 MAILED.

Mr. John C. Roberts,
463 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of
Harold D. Arnold, Ser. #406,695, filed Aug. 28, 1920.
Vacuum Tube Amplifiers.

Thomas E. Robertson
Commissioner of Patents.

This action is responsive to amendment filed March 22, 1922.

Upon careful reconsideration of this case, it is thought claims 5 to 7, 13 and 14 are too broad in view of ARNOLD, 1,129,942, March 2, 1915, 179-171 Gas; Fig. 6 of which discloses choke coils 17 functioning to prevent plate current variations in one tube from affecting the other through the common path of plate battery 18. These claims are, accordingly, rejected. With regard to claims 3 and 4, which apparently read directly on the patent, the lack of copendency between the application upon which said patent was granted and the present application is noted, and this fact, in view of ex parte Mullen and Mullen, 30 OG 837, (class 2), appears to prevent the subsequent claiming of any matter disclosed therein. In claims 5, 6, 7, 13 and 14, it is thought "filter" may very properly comprise a choke coil, particularly if discrimination is desired between different species of current, and the claims are not otherwise limited. Furthermore, if applicant should desire to recite a network instead of a filter, he will note that Arnold also discloses network 17, 18, 14 between each tube and the common plate battery. In the light of applicant's

argument, claims 5, 6, 7, 13 and 14 are again rejected on the BRITISH patent for reasons of record since it is contended that a resistance with a condenser in shunt thereto clearly comes within the meaning of "filter" when looked at from the point of view of either frequency or amplitude discrimination. Applicant, undoubtedly, should limit said term since it is of very broad scope and comprises structure which may be totally different from that argued for.

All other claims appear allowable.

Inasmuch as this case has an effective filing date of seven years, a prompt response should be made, placing it in condition for final action before the examiner.

C. O. Rockwell

Exr., Div. 16.

NSWB.

956

Case 56-A

PAPER NO. 10
LETTER

MAIL ROOM
FEB 6 1923
U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 112

In re application of

HAROLD D. ARNOLD

Serial No. 406,695

Filed August 28, 1920

Subject.

VACUUM TUBE AMPLIFIERS

PATENT OFFICE
FEB 13 1923
U.S. PAT. OFF.

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

This is in response to the Office action of January 11, 1923.

Reconsideration of the rejection of claims 5 to 7, 13 and 14 on Arnold patent No. 1,129,942 is requested. It is submitted that the claims in this application which are readable on the above referred to patent are classifiable in the third class described by the Commissioner in ex parte Mullen and Mullen, 50 O.G.857. The history of this application and of application Serial No. 285,857 from which this application was divided shows that this application was filed in response to a requirement of division in the parent case. Division was required between claims corresponding to the claims in this application and a set of claims covering a feature of the same circuit which is at least as closely related to the present claims as is the subject matter claimed in the above Arnold patent. The claims in this application relate to power supply for vacuum tubes while the claims in the patent relate to the transmission characteristics of vacuum tube circuits. As far as the invention of the patent

is concerned it is immaterial whether power is supplied from a common battery or from separate batteries. It is, therefore, requested that the Arnold patent be withdrawn as a reference.

Reconsideration of the rejection of claims 5, 6, 7, 13 and 14 on the British patent Marconi is also requested. The condenser and resistance combination shown in Fig. 4 in each of the plate leads is not described as being a filter and it cannot be intended to serve as a filter, since in each case it must be traversed by all the alternating currents present. The applicant feels very strongly that he should not amend these claims, particularly claims 13 and 14 which he won in the interference with Alexanderson patent No. 1,312,797. The British patent was of record prior to the declaration of the interference, and it is not a clear anticipation of the claims. That the claims may prove to be broad enough to read in terms on some circuit developed in the future which is not within the equivalents of the applicant's invention, is only what occurs in a great many patents. When patents are granted it is very seldom that all the equivalents of the invention are known and it is impossible in many cases to define in words the exact equivalents of the invention. In such cases claims should be allowed which are as broad as the prior art will admit. The question of whether a particular future development is an infringement of the protected invention must necessarily be deferred until the situation arises. The patent then 62/25

may be construed by the proper persons or courts.

Favorable reconsideration and allowance of the application is solicited.

Respectfully,

HAROLD D. ARNOLD.

By Jas. R. Holmes
Attorney

455 West Street,
New York, N. Y., Feb 10th, 1926.

62/21

HAW-EH

16 Room 112 HHB:LBC

Paper No. 11

959

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Feb. 28, 1923

PATENT OFFICE FEB 28 1923 MAILED

Mr. John G. Roberts,
463 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of
Harold D. Arnold, Ser. No. 406,695, filed Aug. 28, 1920.
Vacuum Tube Amplifiers.

Thomas E. Robertson
Commissioner of Patents.

This action is responsive to letter filed Feb. 12, 1923.

Upon careful reconsideration in view of applicant's argument, claims 5, 6 and 7 are again rejected as pointing out structure unpatentable over BRITISH patent, 13,248, 1914, for reasons of record. It is thought that the resistances interposed between generator G, Fig. 4, and plate electrodes of tubes V, V_1 are very properly such as to come within the definition of the term, "filter", particularly when this term is considered as embracing a discriminatory or limiting means of amplitude. By reference to Fig. 1 of the patent, including description thereof, the exact function of resistance Rg in the several system diagrams may be determined, and it is contended that "filter" is by no means limited to that of frequency per se.

Claims 13 and 14 are deemed to be allowable in view of the statement that the filters are connected between successive amplifiers.

The patent to ARNOLD is withdrawn.

This action is made final, but the examiner will admit any amendment that will allow him to pass the case to issue.

Ex. Div. 16

960

Case 36-A

PAPER NO. 12
AMENDMENT C

MAIL ROOM MAR 9 1923 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 112

In re application of

HAROLD D. ARNOLD

Serial No. 405,695

Filed August 28, 1920

Subject.

VACUUM TUBE AMPLIFIERS

MAR 10 1923

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of February 28, 1923, please amend the above entitled application as follows:

Cancel claims 5, 6, and 7, and renumber the remaining claims in order.

R E M A R K S

The above amendment is believed to place this application in condition for allowance and such action is solicited.

Respectfully,

HAROLD D. ARNOLD,

By Jos. C. R. Palmer
Attorney.

465 West Street,

New York, March 9th, 1923.

HAW:EP

PLAINTIFF S' EXHIBIT No. 63

-36-

961

NUMBER (Series of 1913). 285857

1919

(EXT'S BOOK) 1-7-9

DIV. H 51

PATENT No. 1520994

DEC 30 1924

Name Harold D. Arnold,
Assr. to Western Electric Company, Incorporated, of New York, N.Y. a corp. of New York.

of Maplewood,
County of
State of New Jersey.
Invention Electron Discharge Vacuum Tube & Amplifiers

	ORIGINAL	RENEWED
Petition	Mar. 28, 1919.	, 191
Affidavit	" " , 1919	, 191
Specification	" " , 1919	, 191
Drawing	" " , 1919	, 191
Photo Copy	, 191	, 191
First Fee Cash	$15 Mar. 28, 1919.	, 191
" " Cert.	, 191	, 191
Appl. filed complete	Mch 28, 1919	, 191
Examined and Passed for Issue	June 3, 1924	, 191
C.D. Rarick Exr. Div.	16	Exr. Div.
Notice of Allowance	June 9, 1924	, 191
Final Fee Cash $20	Dec 1, 1924	DEC 30 1924, 191
" " Cert.	, 191	, 191
		, 191
Patented		, 191

Filed Sept 3, 1919

DIVISION OF APPLICATION 36 FILED

Attorney DeMott & Tanner and John G. Rohrer, Toledo, Ohio

Associate Attorneys ~~D.C. Dunlap~~ 463 West St. ~~J.C.R. Graham~~, New York, N.Y., E.N. Adams 463 West Street

(No. of Claims allowed 15.) Print Claims 1, 7, 11 to O.C. (Cl. 179-171)

Title as allowed Electron Discharge Amplifiers

Address

962

This invention relates to electron discharge devices ~~vacuum tube amplifiers~~, and more particularly to an arrangement for and method of varying the ratio of amplification of an electron discharge ~~vacuum tube~~ amplifier.

It is an object of the invention to provide means whereby the ratio of amplification can be varied without varying the impedance presented by the amplifier as a whole to the impulses which are to be amplified.

This is accomplished in the preferred form of the invention by the use of an impedance shunted across the terminals of the secondary of a transformer used to step up the voltage of the incoming currents. The cathode of an electron discharge ~~vacuum~~ tube of the three-electrode type is connected to one end of this impedance, and a connection is made from the control electrode by means of an adjustable contact to a desired point on the impedance, thus varying the proportionate part of the potential drop across the impedance which is applied between the control electrode and the cathode, and correspondingly varying the amplification in the output circuit of the tube.

A specific feature of my invention is the incorporation of the above described controlling arrangement in the output-input coupling between two stages of a multi-stage amplifier. With this arrangement, a single source of space current is used to energize both tubes, and in the branches of the circuit therefor are interposed filters of series inductance and shunt capacity to prevent alternating current from being by-passed therethrough.

The invention described and claimed herein is divided out of my application Serial No. 48,875, filed ~~September 5, 1925~~, and the invention claimed herein is ~~disclosed~~ in my patent No. 1,504,537, August 12, 1924.

63/2

related to the invention claimed in my pending application Serial No. 274,750, filed February 2, 1919, issued as patent no. 1,448,550, March 13, 1923.

For further details, reference may be made to the accompanying drawings in which the single figure illustrates diagrammatically a two stage amplifier embodying the invention.

Referring to the drawing by reference numerals, the amplifier set comprises a tandem arrangement of two vacuum tubes 10 and 11 each having a cathode 12, a grid or control electrode 13, and an anode 14. The cathodes 12 are maintained in a condition of thermionic activity by currents from sources 15.

The input circuit of tube 10 comprises terminals 16, 17, adapted to be connected to a suitable source of electric impulses to be repeated, a resistance 18 bridged across the input electrodes, and a battery 19 adapted to maintain the grid electrode at a negative potential with respect to the cathode. Current between the anode and cathode is supplied from battery or other suitable source 20, the current passing in series through the inductance 21 and the transformer primary 22. A shunt condenser 23 provides a path for the alternating current.

The transformer secondary 24 has connected across its terminals a resistance 25, one end of which is connected to the cathode of tube 11. A connection from resistance 25 to the grid of tube 11 comprises the movable contact 26 and the battery 27, the function of the latter being to provide the necessary negative potential on the grid.

Direct current is supplied to the tube 11 from source 20, through inductances 28 and 29, and grounds 30 and 31. Condenser 32 is shunted across the direct current circuit. The output circuit for alternating current comprises

the condenser 33 and the primary 34 of a transformer, the secondary of which is adapted to be connected through terminals 36 and 37 to any suitable receiving circuit.

In operation, the signals or other impulses, which are repeated and amplified by the tube 10, are impressed on the resistance 25 by currents induced in the secondary coil 24. The input electrodes of the second tube are in shunt to an adjustable part of the resistance 25, and therefore any desired proportionate part of the potential drop across the resistance may be impressed between the input electrodes, with the result that the ratio of amplification may be varied between a predetermined maximum and zero.

Since the grid is at a negative potential with respect to the cathode, no current can flow therebetween, and since the capacity of these electrodes is negligibly small, the impedance of the tube to the signals is substantially infinite. It is thus seen that at all positions of the contact 26 the impedance of the second amplifying unit to the incoming impulses has substantially a constant value, namely, that of the finite resistance 25.

While I have shown and described one embodiment of the invention, it is obvious that it may assume any desired form within the scope of the appended claims. For example, the first amplifying unit with its output transformer might be replaced by any suitable circuit adapted to have electric currents produced therein. Other modifications will occur to anyone skilled in the art.

WHAT IS CLAIMED IS:

1. In combination, a vacuum tube repeater, a circuit containing a source of electric impulses to be repeated, an impedance in shunt to said source, a connection from said circuit to an electrode of said vacuum tube, and a connection from a point intermediate the ends of said impedance to another electrode of said vacuum tube.

2. In combination, a vacuum tube repeater, an input transformer therefor, an impedance connected across the terminals of the transformer secondary, a connection from said impedance to an electrode of said vacuum tube, and a connection from a point intermediate the ends of said impedance to another electrode of said vacuum tube.

3. In combination, a vacuum tube repeater having input electrodes, a circuit containing an impedance, means for producing alternating current through the whole of said impedance, a connection from said circuit to one of said input electrodes, and a connection from an adjustable point on said impedance to another of said electrodes.

4. A vacuum tube repeater comprising a vacuum tube having a high internal impedance, a circuit containing an impedance, means for impressing the impulses to be repeated on said circuit, and means for connecting said internal impedance in shunt to an adjustable amount of said circuit impedance.

5. A vacuum tube repeater comprising a vacuum tube having input electrodes, an input transformer, a resistance bridged across the secondary of said transformer, a connection from one of said electrodes to said resistance, and an adjustable connection from the other of said electrodes to a point on said resistance.

6. In combination, a vacuum tube having input and output electrodes, an electric circuit including a resistance connected to one of said input electrodes, a connection from an adjustable contact on said resistance to the other of said input electrodes, means for producing an alternating current through the whole of said resistance, and means connected to said output electrodes for transmitting an amplified current of substantially the same wave form as said first mentioned current.

7. In a multi-stage amplifier, a coupling between stages comprising a resistance electrically in the output circuit of one amplifying unit, a connection from said resistance to an electrode of the succeeding amplifying unit, and a contact movable along said resistance and connected to another electrode of said succeeding amplifying unit.

8. In a multi-stage vacuum tube amplifier, two vacuum tubes each having a cathode, an anode, and a control electrode, a circuit containing a resistance electrically connected to the cathode and anode of one of said tubes, a connection from said circuit to the cathode of the other of said tubes, and a contact movable along said resistance and connected to the control electrode of said last mentioned tube.

9. In a multi-stage vacuum tube amplifier, two vacuum tubes each having input and output electrodes and a coupling therebetween comprising a transformer having its primary connected to the output electrodes of one of said tubes, a resistance connected across the secondary of said transformer, a connection from said resistance to an input electrode of the other of said tubes, and a connection from an adjustable point on said resistance to the other input electrode of said last mentioned tube.

10. In a multi-stage vacuum tube amplifier, a vacuum tube, a resistance, means for applying changes in the output voltage of said vacuum tube across said resistance, a second vacuum tube, and means for applying a selected part of the drop in potential across said resistance to said second vacuum tube.

11. The method of operating a vacuum tube amplifier which comprises supplying alternating current to be amplified, ~~maintaining the impedance opposed to said amplifying current substantially constant,~~ and varying the ratio of amplification.

12. The method of operating a vacuum tube, amplifier having input electrodes which comprises supplying alternating current to be amplified, maintaining the impedance opposed to said alternating current substantially constant and varying the ratio of amplification by applying a selected part of the potential of said alternating current to said input electrodes.

13. The method of operating a vacuum tube amplifier, which comprises supplying alternating current to be amplified, varying the ratio of amplification while maintaining the impedance opposed to said alternating current substantially constant and transmitting a current through the output circuit having substantially the same wave form as that of the incoming current.

14. The method of operating a vacuum tube amplifier having input electrodes which comprises supplying alternating current to be amplified, changing the potential of said current at a fixed ratio of transformation, and applying a selected proportionate part of the potential of the transformed current to said input electrodes.

Insert C
Insert D
Per A

15. In combination, a plurality of vacuum tube repeaters and a common source of space current for said repeaters, the circuit between each of said repeaters and said source comprising series inductance and shunt capacity.

16. In combination, a plurality of vacuum tube repeaters and a common source of space current for said repeaters, the circuit between each of said repeaters and said source comprising series inductance and shunt capacity.

17. In combination, a plurality of vacuum tube repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from one of said repeaters from flowing in the portion of the space current circuit common to said repeaters.

18. In combination, a plurality of vacuum tube

repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from flowing from each of said repeaters to the others of said repeaters through the portion of the space current circuit common to all.

19. In combination, a source of current, branched circuits therefrom to a plurality of vacuum tube repeaters for supplying space current thereto, and a wave filter in each of said branches.

HAM-EW
EG

In Witness Whereof, I hereunto subscribe my name this 26th day of March, A. D. 1919.

Harold D. Arnold.

OATH.

State of New York }
County of New York } ss.

HAROLD D. ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of Maplewood, in the County of Essex and State of New Jersey, and that he verily believes himself to be the original, first, and sole inventor of the improvement in VACUUM TUBE AMPLIFIERS described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that the said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the United States, except as follows:

Harold D. Arnold

Sworn to and subscribed before me this 26th day of March 1919.

Walter J. Santoro
Notary Public.

971

Div. 16 Recd 12 LBS

Paper No. 28

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Sept. 24, 1919

Mr. John S. Roberts,
468 West St.,
New York, N. Y.

U.S. PATENT OFFICE
SEP 24 1919
MAILED

Please find below a communication from the EXAMINER in charge of the application of

Harold D. Arnold, Ser. 4286,887, filed March 28, 1919.

Vacuum Tube Amplifiers.

James T. Newton
Commissioner of Patents.

This application has been examined.

Page 2, line 9, "ia" should be is

Page 4, line 3, "35" should be 36.

Claims 1 to 14 inclusive are specific to the impedance in control circuit of the amplifier, while claims 15 to 19 inclusive are specific to the filter connections between the common battery and the amplifier; division is required between these two groups of claims inasmuch as they cover two distinct inventions, one independent of the other, and not cooperating with each other to produce a new result as a consequence of the combination.

Record is made of the following patents:

COLPITTS,	1,129,969, March 2, 1915,	179-171;
MEISSNER,	1,170,552, Feb. 8, 1916,	250-27x;
DE FOREST,	1,201,272, Oct. 17, 1916,	250-27x;
LOGWOOD,	1,216,195, March 6, 1917,	250-27x;
CAMPBELL,	1,227,113, May 22, 1917,	250-27x;
LAFOUIR,	1,278,687, July 23, 1918,	250-27;
FR. PATENT (VON LIEBEN ET AL),	Addition 15,726 of 1911, 1 sheet,	250-27.

Further action on the merits is deferred pending compliance with the requirement of division.

C. O. Bamforth
Examiner, Div. 16.

1972

Case 36

PAPER NO 5
AMENDMENT A

MAIL ROOM AUG 26 1920 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE. + Oath

Division 16 Book 112

In re application of

HAROLD D. ARNOLD

Serial No. 285,847

Filed March 28, 1919.

Subject

VACUUM TUBE AMPLIFIERS

SEP 1 1920

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of September 24, 1919, please amend the above entitled application as follows:

Page 2, line 9, change "in" to --is--.

Page 4, line 3, change "35" to --36--.

Cancel claims 15 to 19 inclusive.

Add the following claim:

--15. The combination with a circuit having high impedance, of a transformer for impressing electromotive force upon said circuit and a potentiometer arrangement for connecting the secondary of said transformer to said circuit--.

REMARKS

Claims 15 to 19 have been cancelled in response to the requirement for division.

New claim 15 is along the lines of claims 1 to 14 which have been retained. Action on the merits of these claims is respectively requested.

(Serial No. 285,697) -2-

A new oath appropriate to a divisional application is filed herewith.

Respectfully,

HAROLD D. ARNOLD

By W. A. Beatty
Attorney

463 West Street,
New York Aug 24, 1920.

HAM:FS

971

#5

HAROLD DEFOREST ARNOLD
Serial No. 285,857
Filed March 30, 1910.

Subject:
Vacuum Tube Amplifiers

SEP 1 1920

OATH

County of New York
State of New York } ss.

HAROLD DEFOREST ARNOLD, being duly sworn, deposes and says that he is the applicant in the above entitled application, that he is a citizen of the United States and resident of Maplewood, in the County of Essex, and State of New Jersey, and that he verily believes himself to be the original, first and sole inventor of the improvement in VACUUM TUBE AMPLIFIERS, described and claimed in said application; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to the application of which this is a division, or in public use or on sale in the United States for more than two years prior to the application of which this is a division; that said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to the application of which this is a division; that no application for patent on said improvement has been filed by him or his legal representatives or assigns in any country foreign to the United States prior to the filing date of said application of which this is a division; that the subject-matter claimed herein was a part of the invention disclosed in said original application was invented before he

(Serial No. 285,287) -2-

filed said original application and has not been abandoned.

Harold O. Forest Arnold

Sworn to and subscribed before me
this 30th day of August, 1920.

Jacob F. Gilbert
Notary Public
[illegible]
[illegible]

Div. 16 Room 112 LDG e-app 1

Paper No. 6

Address only
The Commissioner of Patents,
Washington, D. C.,
and not any official by name.

All communications regarding this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON Feb. 24, 1921

Mr. John G. Roberts,
463 West St.,
New York, N. Y.

U.S. PATENT OFFICE
FEB 24 1921
MAILED

Please find below a communication from the EXAMINER in charge of the application of

Harold D. Arnold, Ser. #285,857, filed March 26, 1919.

Vacuum Tube Amplifiers.

M. H. COULSON
Acting Commissioner of Patents.

This action is responsive to amendment filed August 31, 1920.

Claim 1 is rejected as pointing out nothing patentable over LANGMUIR or CAMPBELL of record, attention being called to adjustable rheostats 22, 10 in Figs. 2 and 10 of the respective references.

Claim 3 is rejected directly on CAMPBELL, and no invention is conceded in making the tap on resistance 10 adjustable.

Claim 4 is rejected as being met by LANGMUIR of record.

In claim 8, line 4, should not "inductively" be inserted before "connected" to render the claim strictly descriptive?

In claim 11, it is not apparent how "maintaining the impedance . . . substantially constant" reads on applicant's disclosure. Furthermore, what element is intended to be designated by "amplifying current"?

Claim 15 is rejected on the BRITISH patent cited, noting particularly the adjustable potentiometer arrangement I shunted across the secondary of transformer H in Figs. 2 and 3 thereof.

Ser. 288,857 - 12.

All other claims appear allowable.

Inasmuch as this case has an effective filing date of more than five years, it comes within the provisions of Commissioner's Order 2210, 216 O.G. 1, concerning long pending applications. Applicant is urged to make a prompt reply placing the case in condition for final adjudication before the examiner.

Exr., Div. 16.

6/17

RAB

978

Case 36

PAPER NO. 9
AMENDMENT B

UNITED STATES PATENT OFFICE.

Division 16 Room 118

4270

In re application of
HAROLD D. ARNOLD

Subject.
VACUUM TUBE AMPLIFIERS

Serial No. 285,857
Filed March 28, 1919

PATENT OFFICE
FEB 21 1922
RECEIVED

THE COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

In response to the Office actions of February 24, 1921 and March 30, 1921, please amend the above entitled application as indicated below:

In the preamble, cancel "VACUUM TUBE" and substitute --ELECTRON DISCHARGE--.

Page 2, lines 1 to 2, change "vacuum tube amplifiers" to --electron discharge devices--;

lines 3 to 4, change "a vacuum tube" to --an electron discharge--;

line 13, change "a vacuum" to --an electron discharge--.

Claim 1, line 1, change "vacuum tube" to --an electron discharge--, after "repeater" insert --comprising two electrodes--;

line 2, before "electric" insert --alternating current--;

line 3, cancel "a".

Cancel lines 4 to 7 and substitute:

--the means for effectively connecting said electrodes across an adjustable amount of said impedance.--.

(Serial No. 335,857) --2.

Claim 3, line 1, change "a vacuum" to --an electron discharge--, cancel "repeater";
line 3, change "current through" to --voltage across--;
line 4, cancel "a connection from said cir-".

Cancel lines 5 to 7 and substitute:
--and means for effectively connecting said electrodes across an adjustable amount of said impedance.--.

Claim 4, line 1, change "A vacuum tube" to --An electron discharge--, and change "a vacuum" to --an electron discharge--;
line 4, before "connecting" insert --effectively--.

Claim 8, line 4, before "connected" insert --effectively--.

Claim 11, lines 3 to 4, cancel "maintaining the impedance opposed to said amplifying current substantially constant,";
line 5, cancel the period and substitute --while the impedance opposed to said alternating current remains substantially constant.--.

Claim 13, line 1, change "a vacuum tube" to --an electron discharge--.

Cancel claim 15.

R E M A R K S

Claim 1 has been so amended that it patentably distinguishes from Langmuir, as does claim 3, by the limitation to a system in which an alternating emf is impressed on the impedance. Moreover, since Langmuir is a copending patent and the invention set forth in the claim obviously is not identical with any invention disclosed in the patent, it is thought that the claim is not properly rejectable on the patent.

This copending patent can not sustain a rejection on the ground of anticipation, and substantial identity of invention would be necessary to sustain a rejection on the ground of priority. (Ex parte Thomas, 251, OG 899)

Regarding the rejection of claims 1 and 3 on Campbell, that patent fails to give any suggestion whatever of adjusting the point of connection of the grid or filament lead along the resistance, and it is clear that Campbell had no more idea of varying the grid potential in a manner that would maintain the impedance presented to the source constant than had any one who used a vacuum tube amplifier. Further, it is thought that because of evident lack of identity of disclosure the copending Campbell patent is not properly citable against these claims.

Hammond and Hammond [illegible] copending [illegible] patent against the invention

2

Moreover, it is believed that the applicant's affidavit presented herewith is competent to dispose of the Langmuir and Campbell patents with respect to claims 1 and 3 and also with respect to claim 4.

Although claims 1, 3 and 4 have been changed in some respects, the changes appear to be of such nature as not to disturb the patentability of the claims over the references other than Campbell and Langmuir; and moreover, the affidavit mentioned above carries the applicant's date back of all of those other references, except Van Eicken and Chambers. Further, Meissner, DeForest, and Logwood are copending patents, and therefore would not be competent to sustain a rejection on the ground of anticipation.

It is thought that the amendments directed above to claims 8 and 11 render those claims accurately descriptive and clear, and put them in the condition in which the Examiner apparently believed that they would be allowable.

(Serial No. 265,857)

The amendment directed above to allowed claim 18 does not disturb the patentability of the claim over the references.

Former claim 18, which was rejected, has been cancelled.

Reconsideration and allowance of the application are requested.

Respectfully,

HAROLD D. ARNOLD,

By _____ Attorney.

463 West Street,

New York, July 18, 1922.

SLL:EF

UNITED STATES PATENT OFFICE

MAIL ROOM FEB 1922 U.S. PATENT OFFICE

In re application of

HAROLD D. ARNOLD

Serial No. 285,857

Filed March 28, 1919

Subject:

VACUUM TUBE AMPLIFIERS.

PATENT OFFICE FEB 21 1922

State of New York }
County of New York } ss.

A F F I D A V I T

HAROLD D. ARNOLD, being duly sworn deposes and says that he is the applicant in the application identified above; that the circuit shown on the attached print marked Exhibit A, represents a vacuum tube amplifier circuit which was set up and tested under his direction prior to February 5, 1914, in the research laboratory of the Western Electric Company, at 463 West Street, New York City, New York; that in this circuit a resistance was connected across a source of alternating potential difference and the grid and filament of the vacuum tube were effectively connected across an adjustable amount of said resistance; that currents of a frequency within the voice range were sent through said resistance and the voltage impressed across the input electrodes of the vacuum tube was varied by changing the adjustable connection between said input electrodes and said resistance to vary the amount of said resistance across which said input electrodes were connected; that said currents were amplified in a satisfactory manner; that said print is a copy of a drawing which was made prior to February 5, 1914; that he does not know and does not believe that the invention has been in public use or on sale in this country or patented or described in any printed publication in this or any foreign country for more than two years prior to his original application of which this is a division; and that he has never abandoned the invention.

Harold D. Arnold

Sworn to and subscribed before
me this 21st day of February, 1922.

Notary Public.

Notary Public, Queens County
Certificate Filed in New York County
Commission Expires March 30th, 1923

M.L.:EF

Output thru 110" in Series with Secondary Transformer

Arnold Transformer used

Plate Voltage = 24

Filiment I = .25 amp.



Misapplication of
Harold D Arnold
Serial No. 285857
Filed March 28, 1919

Exhibit A.

981

Div. 16 Room 112 HHB:LBL Paper No. 10

Address only "The Commissioner of Patents, Washington, D. C." and not to any officer by name.

All communications regarding this application should give the serial number, date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON Jan. 19, 1923

Mr. John G. Roberts,
465 West St.,
New York, N. Y.

PATENT OFFICE JAN 19 1923 MAILED

Please find below a communication from the EXAMINER in charge of the application of
Harold D. Arnold, Ser. #285,857, filed March 28, 1919.
Electron Discharge.

Thomas E. Robertson
Commissioner of Patents.

This action is responsive to amendment filed Feb. 20, 1922.

Record is made of

DE FOREST, 979,276, Dec. 20, 1910, 250-18;
DE FOREST, 1,375,447, Apr. 19, 1921, 179-100.2.

Claims 1, 3, 4, 7 and 8 are rejected as defining nothing patentable over DE FOREST, 1,375,447, Fig. 4 of which discloses the plate circuit of tube 52 as constituting an adjustable resistance connected between electrodes 65, 66 of tube 58. In claim 7, line 3, should not effectively be inserted after "resistance"; otherwise this claim appears to be misdescriptive. Claims 1, 3 and 4 are further rejected on the disclosure of Fig. 6 in DE FOREST, 979,276, the application of which appears obvious.

All other claims appear allowable.

In view of the affidavit offered under Rule 75, the CAMPBELL and LANGMUIR patents are withdrawn.

In view of the long pendency of this case, applicant should respond promptly.

Examr., Div. 16.

11475

985

Case 60

PAPER NO. 12
AMENDMENT C

MAIL-ROOM OCT 15 1923 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 112

4275

In re application of

HAROLD D. ARNOLD

Subject.

Serial No. 235,857

Filed March 28, 1918

ELECTRON DISCHARGE AMPLIFIERS

OCT 16 1923

THE COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

In response to the Office action of January 19, 1923, amend as indicated below:

Rewrite claims 1, 3 and 4 as follows:

1. In combination, an electron discharge relay comprising an anode, a cathode and a control electrode, a circuit containing a source of alternating current electric impulses to be relayed, an impedance in shunt to said source, and means comprising a contact movable along said impedance for effectively connecting said control electrode and said cathode across an adjustable proportion of the whole of said impedance.

3. In combination, an electron discharge relay having an anode, a cathode and a control electrode, a circuit containing an impedance, means for producing alternating voltage across the whole of said impedance, and means comprising a contact movable along said impedance for

Serial No. [illegible]

effectively connecting said cathode and control electrodes across an adjustable proportion of the whole of said impedance.

4. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said electrodes, said amplifier having a grid electrode for controlling such space current, means for making said grid negative with respect to said cathode, and means between said line and the input electrodes for making the impedance of said amplifier as seen from said line substantially of a constant value, said last mentioned means comprising a potentiometer arrangement including an impedance and a contact movable along said impedance for varying the voltage supplied to said input electrodes.

Claim 2, line 1, after the comma insert --two amplifying stages each including an electron discharge amplifier,--; line 2, before "stages" insert --said--; same line, after "amplifier" insert --effectively--; line 3, cancel "connection from an adjustable point on said" and substitute --contact movable along said resistance and connected--; line 4, cancel "resistance".

Claim 3, line 3, cancel "connection from an adjustable point" and substitute --contact movable along said resistance and connected--; line 4, cancel "on said resistance".

63/26

Add the following claim:

C 4

15. The combination of an incoming line, an electron discharge relay of the three-electrode type, a transformer coupling said line to said relay, one coil of said transformer being inductively connected to the input electrodes of said relay, and a potentiometer arrangement in shunt to one of the coils of said transformer, said potentiometer arrangement comprising an impedance and a contact movable along said impedance for varying the voltage applied to said input electrodes without materially varying the impedance facing said line.

REMARKS

The Examiner's suggestion that "effectively" be inserted after "resistance" in line 2 of claim 7 has been followed although it seems clear that since the resistance is inductively connected in the output circuit of one amplifying unit it is connected in the output circuit of that unit. Being in that circuit it is, of course, also effectively in that circuit.

The applicant, of course, has no desire to cover circuits such as those shown in the de Forest patents cited in the last Office action. Claims 1, 3 and 4 are each adequately distinguished from de Forest 979,276 wherein there is no three-electrode electron discharge relay, amplifier or repeater, as called for in each of these claims. De Forest made no attempt to solve the applicant's problem of varying the relaying or amplifying effect of a vacuum tube relay without materially varying the impedance facing the source, and the patent, of course, discloses no solution such as that

2/27

expressed in these claims. Moreover, these three claims clearly distinguish patentably from de Forest 1,575,447 wherein there is no contact movable along an impedance for connecting the input electrodes of the relay across an adjustable proportion of the whole of the impedance, or for varying the voltage supply to the input electrodes of the relay without materially changing the impedance facing the line.

Regarding the rejection of claim 7 on de Forest 1,575,447, this claim now specifies a resistance in a coupling between two stages, in addition to the two amplifying stages, each of which includes an electron discharge amplifier. Moreover, this claim now recites a contact movable along the resistance and connected to an electrode of the second amplifying unit, which is a structure widely different from anything found in the patent.

Claim 8, as amended, is believed to be patentable over de Forest No. 1,575,447, for the reason given above in connection with claim 7.

The new claim 18 is patentable over the references of record and also over the other claims in the case by virtue of the limitation to the potentiometer arrangement in shunt to one of the coils of the transformer coupling the line to the relay. This claim is similar to claim 2 of applicant's patent 1,[illegible], March 15, 1925, Thermionic Amplifier Circuits, but is patentable thereover since the potentiometer arrangement enables the voltage applied to the input electrodes of the relay to be varied without changing the impedance facing the source.

Serial No. 888,087 - 5.

Reconsideration and allowance of the application are requested.

Respectfully,

HAROLD D. ARNOLD

By [signature]
Attorney

405 Post Street,
New York, OCT 13 1928, 1928.

HLo40

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1930

Date 26

#13

UNITED STATES PATENT OFFICE

Division 16, Room 112

In re application of HAROLD D. ARNOLD Serial No. 366,667 Filed March 28, 1919	Subject: ELECTRON DISCHARGE AMPLIFIERS

PATENT OFFICE
NOV 15 1924
REC'D FILED

SUPPLEMENTAL OATH

State of NEW YORK
County of NEW YORK } ss.:

HAROLD D. ARNOLD, whose application for letters patent for an improvement in ELECTRON DISCHARGE AMPLIFIERS, Serial No. 366,667, was filed in the United States Patent Office on or about the 28th day of March, 1919, division of original application Serial No. 48,676, filed September 3, 1915, being duly sworn, deposes and says that the subject matter of said application 366,667 as amended August 31, 1920, February 20, 1922, and October 15, 1923, including claims 1 to 14,

was part of his invention, was invented before he filed his original application, above identified, for such invention, was not known or used before his invention, was not patented or described in a printed publication in any country more than two years before his original application, was not patented in a foreign country on an application filed by himself or his legal representatives or assigns more than twelve months before his original application, was not in public use or on sale in this country for more than two years before the date of his original application, and has not been abandoned.

Harold D. Arnold

Sworn before subscribed before me this
7th day of November, 1924.

Notary Public.

HDA:T

63/30

PLAINTIFF S' EXHIBIT No. 64

991

RENEWAL

588285

1912

PATENT No. 1504537

Harold H. Arnold

East Orange Maplewood

New Jersey

Recording Amplifying Device

992

Receiver

NUMBER (Series of 1915). ~~Filed~~ 588285 — 1915 (EXTRA DUPLICATE) 705-3-7 251 100 16

DIV. 16 PATENT No.

Name Harold De Forest Arnold Assignor to Western Electric Company Incorporated New York, N.Y. a corp of Illinois New York.

Of ~~East Orange~~ Maplewood
County of
State of New Jersey
Application Filed ~~Electric Amplifying Device~~ Telephone Communication

Petition	Sept 3	1915	Sept. 14	1922	
Affidavit	" "	1915		191	
Specification	" "	1915		192	
Drawing	" "	1915	130	191	
Photo Copy	Sept 22	1921		191	
Fees Rec'd	15 Sept 3	1915	20 Sept 14	192	
" "		191		191	
Appl. Withdrawn	Sept 3	1915	Sept. 14	192	
Recorded	17	1920	Feb 11	1921	
Notice of Allowance			Rec. Dir.	16	
Final Fee		191	41873 132	191	
		191		191	
Patented				191	

Attorney D. Mitchell Jamieson Leyton & Abbott
Address 463 West Street, New York N.Y.

Class 179 Subclass 171 Power Limiting Amplifying Devices

6 Claims 29 Drawing

230-20

64/2

RENEWAL

NUMBER [illegible] | 588285 | 1915 | (EXPIRATION) 251-110-10

DIV. 16

PATENT No.

Harold De Forest Arnold
Assignor to Western Electric Company of New York
a Corp. of New York

East Orange Maplewood
New Jersey

Power Limiting Amplifying Device

ORIGINAL

Petition Sept. 3 1915.
Affidavit
Specification
Drawing
Photo Copy Apr. 22
Final Fee Paid 15 Sept. 3 1915.
" " Cert.
Appl. filed complete Sept. 3, 1915.

Examined
Sept 14
49873
131
Sept 14
Sept 14
Feb 11
Feb 16

Notice of Allowance
Final Fee Paid
" " Cert.
Patented

Attorneys Dr. Witt C. Tanner and John L. Roberts
463 West Street
New York, N. Y.

Associate Attorneys C. H. Sprague & Co. Syr. N. Y.

Claims allowed 35 Price 30 No. of Claims 25 [illegible]

Title as allowed For the Limiting Amplifying Device



TO ALL WHOM IT MAY CONCERN.

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at ~~East Orange~~ Maplewood, in the County of Essex and State of New Jersey, have invented certain new and useful Improvements in Space Limiting Compliferous Devices, of which the following is a full, clear, concise, and exact description.

~~This invention relates to receiving systems for radio communication.~~

particularly to devices for limiting the electrical power which may be transmitted to a receiving instrument in such a system, and more particularly to devices in which such limiting the magnitude of electromagnetic or equivalent disturbances thereing action is obtained by employing electric currents in an evacuated vessel.

An object is to provide rapidly responsive means by which a definite upper limit is set upon the amount of power which may be communicated to a receiving circuit or apparatus, while amounts of power below said limit may be transmitted without selective interference.

The ability to secure such limitation is desirable in a radio receiving system for example, because foreign disturbances, which in the wireless art are often of large magnitude compared with that of the received signals, may be reduced to a value not exceeding that of the signals, thus securing higher intelligibility in reception.

The object of the invention may be accomplished by the apparatus herein described. This object is accomplished by making use of the fact that unilaterally conducting elements, placed in opposition in a circuit, limit the current which may flow in either direction around that circuit, and in this respect this invention is similar to that which forms the subject of my previous application No. 225,050 for a protection device for electric circuits, filed December 14, 1914, Patent No. 1,160,270 granted January 18, 1916. It differs from that, however, in that additional elements are associated with the unilateral devices, and elsewhere, to secure certain improvements in operation, as explained later in this specification, and also in that an amplifying effect is obtained which makes this device particularly applicable in radio communication.

In the preferred form of this device the unilateral conductivity is secured by causing part of the circuit to lie in the paths of thermionic currents between hot cathodes and

cold anodes, said thermionic currents being oppositely directed with respect to said circuit. These thermionic currents are caused to flow by impressing upon their limiting electrodes, in multiple, an electromotive force operating through a high impedance, said high impedance being essential in the operation of the device for the purpose specified, by preventing unbalanced currents in the two halves of the device. This high impedance serves to differentiate this power limiting device from the repeating device described in U. S. patent No. 1,128,292, to E.H. Colpitts for an Electric Wave Amplifier, as will be apparent from the further explanation of its function given later.

The nature of this invention will be more fully understood by reference to the drawing, which represents a receiving system for radio communication embodying this invention, and in which 1 represents an elevated receiving conductor, 2 a tuning inductance coil, 3 an adjustable condenser, and 4 an adjustable resistance shunting the condenser. By means of the coil 5, the tuned circuit 3, 4 is coupled to the antenna. The terminals of the condenser 4 are connected to the input circuit of the thermionic repeater 7, comprising heated filament 8, grid 9 and plate 10. A battery 11 is preferably connected in the input circuit to maintain the grid at a negative potential with respect to the filament. 12 is a battery which serves to heat the filament 8. The output circuit of repeater 7 contains battery 15 and a choke coil 16, shunted by a condenser 14 to afford a path for high frequency power, and the coils 13 and 17, the latter having reversible inductive connection with coil 5, the sense of its inductive action being controlled by reversing switch 18. The purpose of coil 17 is to neutralize the coupling between input and output circuits of the amplifier 7 and thus prevent free oscillation or "singing". The coil 19, coupled

to 15, connects the above described amplifying circuit to the tuned circuit 19, 20. Across the terminals of condenser 20 is connected the input circuit of a detecting device which comprises thermionic element 21, condenser 22 and resistance 23. The purpose of the combination of the condenser and high resistance in connection with thermionic element 21 is as follows: When a positive charge, for example, is forced upon the grid of element 21, this charge is neutralized by electrons from the filament. Then when, in the next alternation, a negative charge is forced to the grid by the incoming wave, this charge adds to that already present and produces a still larger negative charge upon the grid, since a negative charge cannot be neutralized by the electron stream. The condenser therefore aids in decreasing the average current in the output circuit. The grid must, however, be conductively connected to the incoming circuit, otherwise the accumulated negative charge would remain and prevent further operation. To provide for this, a high resistance leakage path is shunted around the condenser to allow a leak which is slow compared with the period of high frequency currents, but still rapid enough to permit considerable leakage in a time comparable with the period of telephonic waves. The output circuit of this thermionic element is supplied with current by batteries 15 and 27, acting through choke coil 26 and resistance 25, condenser 24 serving as a high-frequency shunt, and condenser 26 to limit the direct current to the detector circuit. 31 is an amplifier having a battery 30 in series with its grid and a resistance 29 across its input circuit. The output circuit of amplifier 31 comprises a battery 34 and choke coil 35, both shunted by condenser 33 and a coil 32. Coil 36, coupled with 32, supplies power to resistance 37, across a portion of which is connected the input circuit of another amplifier 38, having a battery 39 in its grid circuit. The output circuit of amplifier 38 is supplied

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by battery 34 and contains choke coil 42 condenser 40 and coil 41, whose functions are the same as those of the corresponding elements in the previous amplifier. It also contains condenser 43 and coil 44. The apparatus to the right of 44 comprises the power-limiting device and the receiving circuit.

In this device coil 45 is coupled to coil 44. 46 is a resistance. 48, 49 and 53 are the filament, grid and plate, respectively, of a structure of the audion type, as are also 50, 51, 52, respectively. 47 is a battery common to the input circuits of the two structures, which structures may be in the same vessel or in separate vessels. 54 is a transformer winding connecting plates 52 and 53 and having a connection brought out at its middle point. The secondary winding 55 of this transformer leads to a receiving instrument 56, preferably through the condensers 59.

Current is supplied to the output circuits of the last mentioned structures of the audion type by battery 65 connected through coil 57, and the variable resistance 58 to the middle point of coil 54 and to the common point of the two filaments 48 and 50. The receiving set is grounded at the points 60, 61, 62, 63 and 64.

The operation of this system is as follows: Power received by the antenna is transferred to the circuit 5, 6, augmented by amplifier 7, communicated to circuit 19,20, transformed into low frequency form by detection in element 21, augmented by amplifiers 31 and 38, and passed to the receiving instrument through the power limiting device whose operation will now be explained.

The thermionic repeater being unilaterally conducting, the repeater element 48, 49, 53 can transmit positive current due to battery 65, only in the direction from 53 to 48. Also, element 50, 51, 52 can transmit positive direct current only in the direction

from 52 to 50. If these currents are approximately equal, it follows that the maximum variation in current around the circuit 48, 53/54, 52, 50 can never exceed the magnitude of the normal current in either element, provided none of this varied current can pass through the battery 65. To prevent such passage, choke coil 57 is used.

The variations in the normal currents in the winding 55, which variations constitute the signals to be received, are produced in the usual way by the action of the grids 49 and 51, across which the signal voltage is impressed, so that it is obvious that an impressed voltage of large value, tending to produce a large variation of current in the power limiting device, cannot cause an alternating or varying current in winding 55 larger than the normal space current of the elements. This normal space current is adjusted until its value is just greater than the amplitude of the signals to be received.

The resistance 58 prevents serious unbalance of currents in the two halves of winding 54/55, when a large electromotive force is impressed, by lowering the effective potential difference between plate and filament by the amount of the voltage drop in the said resistance, and consequently decreasing the current which can flow in the output circuit of either repeater element, this effect being a fundamental one in the operation of the thermionic repeater.

(30)

WHAT IS CLAIMED IS:

1. A receiving system for radio communication comprising an antenna, a tuned receiving circuit connected therewith, means for amplifying the power of waves communicated to said tuned circuit, means for ~~rectifying~~ detecting said waves of amplified power, means for amplifying said ~~rectified~~ detected waves, translating means responsive to said ~~rectified~~ detected waves, and means including thermionic elements for limiting the power transmitted by said waves to said translating device.

2. In combination with a source of power, a power limiting device comprising ~~a thermionic repeater with~~ divided input and divided output circuits, a connection of said input circuit to said source of power, a high impedance path containing a source of electromotive force and connected between the points of division of said divided circuits, a receiving device and transformer windings for connecting said output circuit to said receiving device.

---

3. A receiving system for radio communication comprising an antenna, a receiving circuit connected therewith, means for amplifying the power of waves communicated to said circuit, means for ~~rectifying~~ detecting said amplified waves, means for amplifying said ~~rectified~~ detected waves, translating means responsive to said ~~rectified~~ detected waves, and a power limiting device comprising a thermionic repeater with divided input and divided output circuits, a high impedance path containing a source of electromotive force connected in the output circuit of said repeater and transformer windings for connecting said output circuit to said translating means.

4. In a power limiting device, the combination of ~~unilaterally conducting thermionic elements~~ a plurality of electron discharge devices connected in

opposition in a circuit, a high impedance path and a source of constant electromotive force in said path, said elements being supplied with current in multiple through said path, auxiliary electrodes for varying said currents in response to an impressed voltage, and a receiving circuit and means for communicating variations in said currents to said receiving circuit.

5. The combination with a receiving system for radio telegraphy or telephony, of a power limiting device comprising unilaterally conducting thermionic elements connected in opposition in a circuit, a high impedance path and means for providing flow of currents through said elements in said path, auxiliary electrodes for varying said currents, a receiving circuit, and means for communicating variations in said currents to said receiving circuit.

RWB-AT

1002

In Witness Whereof, I ___ hereunto subscribe my ___ name this 31 day of August A. D., 1915.

WITNESSES:

Harold DeForest Arnold

State of New York }
COUNTY OF New York } ss.:

HAROLD DeFOREST ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a ___ citizen of the United States, and resident of East Orange in the County of Essex and State of New Jersey, and that he ___ verily believes himself ___ to be the original, first, and sole ___ inventor of the improvement in RADIO COMMUNICATION,

described and claimed in the annexed specification; that he ___ does not know and does not believe that the same was ever known or used before his ___ invention or discovery thereof; or patented or described in any printed publication in the United States of America or any foreign country before his ___ invention or discovery thereof or more than two years prior to this application; or in public use or on sale in the United States for more than two years prior to this application and that no application for foreign patent has been filed by him ___ or his ___ legal representatives or assigns in any foreign country.

Harold DeForest Arnold

Sworn to and subscribed before me this 31 day of August 1915

Robert Gilleaudeau
Notary Public.

NOTARY PUBLIC
NEW YORK COUNTY
NEW YORK CITY

Div. 16 Room 109

"The Commissioner of Patents, Washington, D. C." and not any official by name.

2-889

Paper No. 2

All communications regarding this application should give the serial number, date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

1003

WASHINGTON Jan. 13, 1916.

U. S. PATENT OFFICE JAN 13 1916 MAILED

Mr. John L. Roberts,

463 West Street,

New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

H. DeF. Arnold. S. No. 48,873. filed Sept. 5, 1915.

Radio Communication.

Thomas Ewing
Commissioner of Patents.

This application has been examined.

Page 4, line 27, "39" should be 31.

Page 5, line 31, "53" and "48" should be transposed.

Page 6, line 1, "52" and "50" should be transposed.

Page 8, line 17, "53" should be 58.

Claim 1 is substantially identical in scope as claims in copending application 48,005. A proper line of division should be maintained between the two cases.

Claims 2, 4 and 5 are each rejected on Colpitts, 1,137,384, Apr. 27, 1915, 179 - 171. The double audion arrangement shown in Figure 4, e. g., would limit the power passing therethrough inasmuch as the current in the output circuit is produced solely by the battery 10 and is therefore limited in amount to the capacity of this battery. If the effective resistance of the audions could be reduced to zero by the incoming waves the current in the output circuit would reach its maximum value which would be

limited by the resistance of the output circuit. The input circuit is divided into branches 16 - 7a - 13a - 26 and 16 - 7b - 13b - 26, e. g., while the output is divided into two paths 10 - 7a - 2a - 11 and 10 - 7b - 8b - 11. The term "high impedance" is relative and therefore indefinite. The impedance 11 in the branched output of the reference is relatively high.

Claim 3 is allowed.

Examiner, Division XVI.

CAS

1005

PAPER NO 3
AMENDMENT

MAIL ROOM SEP 1916 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE
DIVISION 16 Room 109

A- 252

In re application of
Harold D. Arnold
Serial No. 48,873
Filed September 3, 1915

Radio Communication.

PATENT OFFICE SEP 2 1916 RECEIVED

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

This is in reply to the Office action of January 18, 1916.

It is respectfully requested that the above entitled application be amended as follows:

Page 4, line 27, change "29" to --31--.

Page 6, line 17, cancel "53" and substitute --58--. Line 18, same page, change "55" to --54--.

Substitute --detecting-- for "rectifying" in line 3, page 4.

Page 5, line 25, change "rectification" to --detection--.

Page 5, line 30, insert --positive-- before "current" Line 32, before "direct" add --positive--.

Add the following at the bottom of page 6:

--Owing to the fact that the vacuum tube repeaters can only transmit current in one direction, it is impossible to do more by any impulse than to decrease the current in one vacuum tube repeater to zero. The current in the other tends to increase

48,873

according to the increase of potential on the grid.

On account of this rise of potential the resistance of the tube decreases, and since the output circuit contains a very high resistance 56, the voltage across the tube decreases. The circuit is so arranged by adjusting the resistance 58 that the fall of potential finally becomes so great as to prevent the rise of current above a certain amount.

If this amount is made approximately equal to the current required to transmit the talk, the interfering sounds, due to accidental causes, cannot possibly be of greater intensity than the speech.--

Claims 1 and 3, line 4, cancel "rectifying" and substitute --detecting--; and in lines 5 and 6 of both claims change "rectified" to --detected--.

Claim 4, line 7, cancel "and" (first occurrence), and change "communicatings" to the singular number.

Add the following claims:

--6. In a receiving system for radio signaling, a power limiting device comprising ~~a thermionic element~~ having input and output circuits, a source of current for said output circuit, and regulating means in the output circuit for preventing the current supplied by said source from exceeding a given value.

7. In a receiving system for radio signaling, a power limiting device comprising ~~a thermionic element~~

48,873

having input and output circuits, a source of power for said output circuit, and means responsive to the current in said output circuit for controlling the potential applied from said source to said ~~thermionic element~~ conductive space whereby the rise of current in said output circuit is limited.

8. In a receiving system for radio signaling, a power limiting device comprising ~~a thermionic~~ an electron discharge element having input and output circuits, a source of current for said output circuit, and a resistance in said output circuit for limiting the rise of current in said output circuit.

9. In a receiving system for radio signaling, a power limiting device comprising ~~a thermionic~~ an electron discharge element having input and output circuits, a source of current for said output circuit, and a resistance serially connected with said source for limiting the rise of current in said output circuit.

10. A receiving system for radio communication comprising an antenna, a receiving circuit connected therewith, means for detecting the waves communicated to said circuit, translating means responsive to said detected waves, and a device for limiting the power transmitted by said waves to said translating means; said device comprising ~~a rectifier~~ an electron discharge device, a source of current therefor, and means for determining the intensity of the effect produced in said translating means by a signal wave of a certain intensity and for preventing waves of greater intensity from exceeding said effect.

11. In a power limiting device, the combination of ~~unilaterally conducting thermionic elements~~ an electron discharge device connected

in opposition in a circuit, said elements having input and output circuits, means for supplying current to said output circuits, means for preventing [illegible] frequency currents from passing through said supplying means, and means for regulating the maximum value of the current furnished by said supplying means.

12. In a combination with a source of power, a power limiting device comprising a thermionic repeater with divided input and divided output circuits, a connection of said input circuit to said source of power, a path connected between the points of division of said circuits; said path comprising a source of electromotive force, means for preventing [illegible] frequency currents from passing through said source, and means for regulating the maximum value of the current supplied from said source; a receiving device, and transformer windings for connecting said output circuit to said receiving device.

13. In combination with a source of power, a power limiting device comprising a thermionic repeater with divided input and divisid output circuits, a connection of said input circuit to said source of power, a path connected between the points of division of said circuits; said path comprising a source of electromotive force, an impedance device for preventing [illegible] frequency currents from passing through said source, and a resistance for regulating the maximum value of the current supplied from said source; a receiving device, and transformer windings for connecting said output circuit to said receiving device.

B. Fallows

Witness: [illegible]

REMARKS

As to paragraphs 3 and 4, page 2 of the Office letter, the drawing shows plates 52 and 53 connected to the positive pole of battery 65, while filaments 50 and 48 are connected to its negative pole. Page 5, line 31, and page 6, line 1, describe that the current flows within the external circuit from the positive to the negative pole of battery. This is customarily considered to be the direction in which the current will flow as the positive pole indicates the pole of higher potential, and it is generally assumed that the current flows in an external circuit from a point of higher to a point of lower potential.

To differentiate from the direction of flow of the negative electron stream, the specification has been amended to show that the positive current is transmitted in the direction indicated.

Claim 1 is retained in this application, and a proper line of division will be maintained with the application to which the Examiner refers.

Reconsideration and allowance of claim 2 are respectfully requested. It is true, as the Examiner states, "that the current in the tube circuit of the system shown in Fig. 4 of the patent 1,127,384 is limited by the capacity of the battery. But this limiting value is too high for practical purposes, and is reduced in the present case to a lower value by means of resistance 58.

The specification has been amended to bring out the fact that resistance 58 is adjusted so that the current cannot rise above a given value due to the IR drop in that resistance.

This limiting value of the current is made approximately equal to the current required to transmit talk. Then a static disturbance which may be many times as strong as the signal, cannot produce in the receiver an effect any greater than that produced by the signal.

The patent to Colpitts supra shows only the low impedance path provided by battery 10 between the points of division of the divided output circuit, whereas, Claim 2 recites a high impedance path containing a source of electromotive force connected between the points of division of said divided output circuit. This clearly differentiates from the patent to Colpitts which does not show impedance 11 connected between the points of division of said divided output circuit, and it is thought that on reconsideration the Examiner will find Claim 2 allowable.

It is noted that Claim 3 is allowable.

It is thought that Claim 4 should be allowed for the reasons noted in connection with Claim 2, and since the patent to Colpitts shows no high impedance path and a source of constant electromotive force in said path, said thermionic elements being supplied with current in multiple through said path. The thermionic elements in the patent to Colpitts are supplied in series through the halves of the impedance 11. The impedance 11 does not supply the elements in multiple. This difference should warrant the allowance of Claim 4.

Reconsideration and allowance of Claim 5 is requested for the reasons noted above, and furthermore, because the patent to Colpitts does not show a high impedance path and means for providing flow of current through said (thermionic) elements in said path. What the patent to Colpitts does show is "two high impedance paths and means for providing flow of currents through each of said elements in one of said paths".

48,875

Claim 5 recites a single high impedance path which carries currents to both the thermionic elements while the reference shows a high impedance path for each element. Since the applicant provides a single impedance path that performs the function of the two paths in the reference, it is thought that this claim should be allowed.

New claims have been added to bring out the function of the resistance 56 to limit the maximum value of the current. This function is described in the last paragraph of page 6, and has been amplified in the paragraph added to that page.

An attempt has been made to overcome the Examiner's criticisms and an early allowance of this case is respectfully solicited.

Respectfully,

HAROLD D. ARNOLD

By H. C. Ebert
Attorney.

463 West Street,

New York, Aug 31, 1916.

WEB-AA

1012

Div. 16 Room 109

Address: "The Commissioner of Patents, Washington, D. C.," and not any official by name.

H.

Paper No. 4

All communications concerning this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON, Oct. 31, 1916.

Mr. John G. Roberts,
463 West Street,
New York, N. Y.

U.S. PATENT OFFICE
OCT 31 1916
MAILED

Please find below a communication from the EXAMINER in charge of the application of

H. DeF. Arnold, S. No. 48,875, filed Sept. 3, 1915.

Radio Communication.

Thomas Ewing Jr.
Commissioner of Patents.

This action is in response to amendment filed Sept. 1, 1916.

Upon reconsideration the rejection of claims 2 and 4 upon Colpitts, 1,187,384, is withdrawn. It is still considered that claim 5 is anticipated by the Colpitts disclosure in view of the fact that the claim does not set forth that the high impedance path may not include inteduance 11, shown in Figure 4, of Colpitts, and consequently it does not distinguish from that reference.

Claims 2 and 4 to 12, inclusive, are rejected upon the subject-matter of the claims in the patent to Arnold, 1,160,270, Jan. 18, 1916, 250-36, I. It is considered that to allow such claims in the present application would amount to double patenting, inasmuch as the claims might have been presented in the prior application.

Claim 13 is also rejected upon the ground that it does not involve invention to supply a regulating resistance in any battery circuit.

Claims 1 and 3 appear allowable.

Examiner, Division XVI.

MAIL ROOM U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 - March 29

In re application of
Harold DeForest Arnold
Serial No. 49,878
Filed September 3, 1915

Radio Communication

PATENT OFFICE MAY 10 1917

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

This amendment is in response to the Office action of October 31, 1916. Please amend as follows:

Claim 4, line 2, cancel "a thermionic" and substitute --audion--; and change "repeater" to --repeaters--.

Claim 6, line 2, cancel "unilaterally conducting thermionic" and substitute --a plurality of audion--.

Claims 6, 7, 8 and 9, line 2, change "a thermionic" to --an audion--.

Claim 7, line 4, cancel "thermionic" and substitute --audion--.

Claim 10, line 3, change "a repeater" to --an audion--.

Claim 11, line 2, cancel "unilaterally conducting thermionic" and substitute --audion--.

Claims 12 and 13, line 2, change "a thermionic repeater" to --audion repeater--.

Cancel claim 5, and substitute the following:

-- 5. The combination of a receiving system comprising two audions, each having an input circuit and an output circuit, a portion of the similar circuits of said audions being in common, a high impedance in the common portion of said circuits, ~~and signal translating means associated with said audions.~~ --

Add the following claim:

-- 14. The combination of a receiving system comprising two audions, each having an input circuit and an output circuit, a portion of said output circuits being in common, a high impedance in the common portion of said output circuits, ~~and signal translating means associated with said audions.~~ --

REMARKS

Claims 2 and 4 to 13, inclusive, have been restricted to "audion" systems which takes these claims away from the valve system shown in the patent to Arnold, 1,158,270. New claims 5 and 14 are also limited to "audion" systems.

Furthermore, the present claim 5 is believed to differentiate from the patent to Colpitts, 1,137,384, of record as this claim recites that the high impedance is included in that portion of the similar circuits of the audions which is common to these audions. In Fig. 4 of this patent to Colpitts only the battery

16 is included in the common portion of the input circuits of the two audions and only battery 10 is included in the common portion of the output circuits. This patent to Colpitts does not show a high impedance in either the common portion of the input circuits or in the common portions of the output circuits. The arrangement defined by claim 5 enables applicant to use an impedance of half the size shown in the patent, since the path for both audions passes through a single impedance, whereas, in the patent, two impedances are in effect provided, one for each audion.

Claim 14 is more specific than claim 5 in that it recites that the high impedance is included in the common portion of the "output" circuits of the two audions.

It is thought that the Examiner will find the claims in their present form to be allowable.

Respectfully,

HAROLD DeFOREST ARNOLD,

By J. F. Roberts
Attorney.

463 West Street,
New York, May 5, 1917.

HDA-AA

1016

16 Room 109

Paper No.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON July 5, 1917.

U.S. PATENT OFFICE JUL 5 - 1917 MAILED

Mr. John G. Roberts,

468 West Street,

New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

H. DeF. Arnold, S. No. 48,875, filed Sept. 8, 1915,

Radio Communication.

Thomas Ewing
Commissioner of Patents.

This action is in response to amendment filed May 9, 1917.

Page 2, line 22, the data of the patent resulting from application No. 877,056 should be supplied.

Page 5, lines 10 and 11 must be fully illustrated as to both modifications, or canceled; line 14, the receiver 66 must be illustrated by standard diagram or labeled.

Claims 2 and 4 to 16, inclusive, are rejected upon the subject-matter of the claims in the patent to Arnold, 1,168,270, of record. The term "audion" does not distinguish from the thermionic elements in the reference Arnold for the reason that this term has been used to loosely define all electron discharge devices comprising a heated filament as one electrode and cannot be considered as limiting the claims to a three electrode element. Note, for example, pages 212-214, inclusive, of "Principles of Electric Wave Telegraphy", by Pierce, 1910, Hough-

48,878 — 2.

Bill Book 26.

Arnold, 1,200,791, Oct. 10, 1916, 250-27.1.

is made of record.

Wm Atkinson

Examiner, Division XVI.

1018

MAIL ROOM JUN 13 1918 PATENT OFFICE

Case 16

PAPER NO 7

AMENDMENT C

UNITED STATES PATENT OFFICE.

Division 16 Room 102

A 26?

In re application of

HAROLD D. ARNOLD

Serial No. 48,873

Filed September 3, 1915

Subject.

Radio Communication

JUN 14 1918

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of July 5, 1917, please amend the above entitled application as follows:

Page 1, line 28, change the title "RADIO COMMUNICATION" to --Power Limiting Amplifying Devices--; same page, cancel the last two lines and substitute therefor,

--This invention relates to power limiting repeating and amplifying devices, and especially to devices of this kind which are adapted to be used in radio communication systems.--

Page 2, line 1, cancel "particularly to devices"; lines 4 and 5, cancel "employing electric currents in an evacuated vessel" and substitute therefor, --utilizing the properties of thermionic or equivalent discharge devices--; line 10, cancel "selective"; after line 16, insert the following paragraph:

--In a general aspect, the object of this invention is to provide improved circuits and means for association with thermionic repeating devices.--; lines 17 and 18, cancel "This object is accomplished by making use of the fact that", and substitute therefor, --The objects of the invention may be accomplished by the apparatus herein

(Serial No. 48,873)

disclosed therein.--; line 22, cancel "previous application No. 877,056" and substitute therefor, --patent No. 1,168,270--; line 23, cancel "filed December 14, 1914." and substitute --granted January 18, 1916.--

Page 5, line 18, after "variable" insert --high--; line 20, after the period insert the following sentence:

C 3 --Condenser 56 and choke coil 57 tend to prevent fluctuations of current from the source 65 from passing through the thermionic elements and coils 54.--

Page 6, line 5, after "through" insert --that part of the circuit of --; same line, after "65" and before the period insert, --which is common to the two thermionic elements--; lines 5 and 6, cancel "to prevent such passage, choke coil 57 is used." and substitute therefor --To prevent any appreciable passage of variable current the high resistance 58 is used.--

C 4

In the insertion at the bottom of page 6, which is found in the amendment filed September 1, 1918, in line 7 thereof, change "current" to --potential--.

Claim 2, line 2, cancel "audion repeaters with" and substitute --electric discharge devices each including an impedance controlling element, said devices having--.

C 5

Claim 4, line 2, cancel "audion elements" and substitute --evacuated vessels each including a unilaterally conductive space, an impedance controlling element for said space, said spaces being--.

C 6

Claim 5, line 2, cancel "audions" and insert --electron discharge devices each including an impedance controlling element--; same line, after "each" insert --said device--; line 3, before "a" insert --and--; line 4, change "audions" to --devices--; line 6, change the comma to

C 7 Per D

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(Serial No. 48,873)

a period and cancel "and signal translating means associated with said audions."

Claims 6 and 7, line 2, cancel "an audion element" and substitute --a conductive space, an impedance controlling element therefor, said device--.

Claim 7, line 6, cancel "audion element" and insert --conductive space--.

Claims 8 and 9, line 2, cancel "audion" and substitute --electron discharge--.

Claim 10, line 6, cancel "audion" and substitute --electron discharge device--.

Claim 11, line 2, cancel "audion elements" and substitute --electron discharge devices each including an impedance varying element--; lines 5 and 6, cancel "high frequency" and substitute --fluctuating--.

Claims 12 and 13, line 2, cancel "audion" and substitute --electron discharge--; line 7 of each, cancel "high frequency" and substitute --fluctuating--.

Claim 14, line 2, cancel "audions" and substitute --electron discharge devices each including an impedance varying element--; line 4, insert --and-- before "a"; line 5, change the comma to a period and cancel lines 6 and 7.

Add the following claims.

15. In combination, a plurality of electronic discharge devices, each of said devices having an impedance varying element, a source of space current for each, and means tending to maintain the sum of the space currents through said devices constant.

(Serial No. 48,873)

16. In combination, a plurality of electrical circuits each of said circuits including a conductive space, ~~one or more elements for varying the impedance of one or more of said spaces respectively~~, a current supply source for said circuits, and means associated therewith tending to keep the sum of the currents through said circuits constant.

Par. 10 " 16-2 Insert E

17. An amplifier comprising two electrical discharge devices, input and output circuits therefor, said devices being symmetrically and oppositely disposed with respect to each of said circuits, space current paths for said devices, said paths having a common external portion of high impedance.

18. An amplifier comprising two electrical discharge devices, input and output circuits therefor, said devices being symmetrically and oppositely arranged with respect to each of said circuits, space current paths for said devices, a source of space current therefor, said paths having a common external portion, and means associated with said source for preventing fluctuating currents therethrough.

19. An amplifier comprising two space discharge devices, input and output circuits therefor, said devices being symmetrically and oppositely arranged with respect to each of said circuits, space current paths for said devices, said paths having a common external portion and a resistance in said portion which is large as compared with

(Serial No. 48,873)

40

the normal impedance of the conductive space of one of said devices.

20. A repeater comprising two electric discharge devices each having a cathode, an anode and an impedance varying element, a connection between said impedance varying elements, a connection between said cathodes, a connection between said anodes, an electrical impedance in one of said connections, an electrical impedance in another of said connections, other connections from intermediate portions of each of said impedances to one of said first mentioned connections, one of said last named connections being provided with a source of current, and means tending to maintain a constant supply from said source.

21. In a repeater, two oppositely disposed electric discharge devices, impedance varying elements for said devices, means for causing one of said elements to increase the impedance of one of said devices, and the other of said elements to decrease the impedance of the other of said devices simultaneously, and means to cause the changes of current through said devices to be simultaneously substantially equal and opposite respectively when said repeater is repeating alternating current.

E³ follows

Sub E³

22. In a signaling system, a power limiting device comprising an electron discharge device

64/32

[Serial No. 48,873]

having input and output circuits, a source of space current for said output circuit, and a resistance in said output circuit of such value that signals will produce a desired change of current but impulses of greater intensity will produce no materially greater change.

Per D

Sub E 4

24. In a signaling system, a power limiting device comprising an electron discharge device having input and output circuits, a source of space current for said output circuit, and a resistance in said output circuit, said source and resistance being of such values that incoming signal impulses will produce desired changes of current, but incoming impulses of greater strength will produce only negligibly larger changes of current.--

Per D

Insert D

REMARKS

In a separate communication it is requested that the various inductance coils in the drawings be changed so they will not be confused with resistances.

In view of the Examiner's suggestion that the term "station" may be construed to include an evacuated vessel having only an anode and a cathode, claims 2, 4, 5, 6, 7, 11 and 14 have been amended to clearly differentiate from applicant's patent No. 1,168,270.

Claims 8 and 9 include a resistance in the output circuit for limiting the rise of current which is not disclosed in the Arnold patent.

4/33

(Serial No. 48,873)

Claim 10 includes a detector and numerous other elements of a receiving system not found in the patent.

Claims 12 and 13 define electron discharge repeaters which are not found in the Arnold patent.

It should be kept in mind that patent No. 1,168,270 was issued upon an application expanding with the present application, and as the law is understood, it is believed that it is not a reference for any invention claimed in this case but the only requirement is that the subject matter claimed herein should constitute an invention which is divisible subject matter from that claimed in the patent. It is believed, moreover, that all the claims are now for combinations not found in the patent.

A number of amendments to the specification have been made with the intent to describe the construction and operation of the invention in clearer language and in greater detail. The function of the condenser 36 which is to eliminate impulses from the source 45 in case the source consists of a dynamo-electric machine or the like has been stated.

On reviewing the case, it has been thought that certain features of the invention were not protected as fully as desirable, hence a number of claims have been added with a view to accomplish this result.

All the added claims are believed to be so drawn as to be patentable over the prior art and to maintain a clear line of division between this application and the more generic patent No. 1,168,270. Claims 18 and 19 for

64/34

(Serial No. 46,873)

example, define an amplifier and the patent does not disclose an amplifier. It should be noted that the patent does not disclose a current limiting resistance, nor the elements of a receiving system, nor discharge devices which have a grid or impedance controlling element.

It is thought that the application is now in condition for allowance and such action is respectfully requested.

Respectfully,

HAROLD D. ARNOLD,

By _____
Attorney

463 West Street,
New York, June 17, 1918.

JWS-LM

15 Room 112 ABS. 980

Paper No. 9

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Sept. 17, 1918.

John G. Roberts, Esq.,
920 Broadway,
New York, N.Y.

...ter ...known ...communication from the EXAMINER ... of ...application of
Harold DeForest Arnold, Ser. No. 48,873, filed Sept. 3, 1915,
"Power Limiting Amplifying Devices."

James T. Hunton
Commissioner of Patents

This action is in response to amendment filed June 15, 1918.

In the drawing the receiver 66 should be shown by the standard symbol for the telephone receiver or else labeled receiving instrument.

The following references are added to the references of record:-

SCHLOEMILCH et al, 1,087,892, Feb.17,1914 (250-42);
DeF. ARNOLD, 1,114,645, Oct. 27, 1914 (179-171)
COLPITTS, 1,128,892, Feb. 16, 1915 (179-170)
ARNOLD et al, 1,221,984, July 3, 1917 (250-20);
LANGMUIR, 1,273,625, July 23, 1918 (171-97);

Marconi, British, 20,441 of 1910, (2 shts.) (250-20).

Claim 4, line 11, "including" should be enclosing, as the space is not a part of the vessel.

Claim 5 is not grammatically complete and should be revised.

In claims 6 and 7, a conductive space is an intangible element and cannot properly be claimed. See ex parte Davin, C. D. 1902 page 252.

Claims 8 and 9 are rejected as defining nothing

patentable over the patent to Arnold, 1,114,845.

Claims 15 and 16, the phrases "one or more" render these claims alternative. These two claims are met in the patent to Langmuir, cited, and are rejected. The inductance 3 is means for maintaining the sum of the space currents through 5 and 14 constant.

Claims 22 and 23 are rejected as defining nothing patentable over the patent to Arnold, 1,114,845, which meets these claims by giving proper values to the resistance 8.

The remaining claims are considered allowable.

As this application has been pending for more than three years applicant's response to this action should be prompt and of such nature to place the case in condition for final action. See Commissioner's order 2210, 216 O.G.1 concerning long pending applications.

R.W.Smith

H.L.M. Acting Examiner, Division 16.

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MAIL ROOM JUN 5 1919 U.S. PATENT OFFICE

Case 16

PAPER NO. 10 AMENDMEN

UNITED STATES PATENT OFFICE.

Division 16 Room 112

A 270

In re application of

Harold D. Arnold

Serial No. 48,873.

Filed September 3, 1915.

Subject.

Radio Communication

PATENT OFFICE JUN 6 - 1919 WASH. D.C.

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of September 17, 1918, please amend the above entitled application as follows:

Cancel the insertion at the end of the specification (bottom of page 6) which was made in the amendment filed September 1, 1916, and substitute therefor the following:

Owing to the fact that the vacuum tube repeaters can transmit current in one direction only, it is impossible to do more by any impulse than to decrease the current in one vacuum tube repeater to zero. The current in the other tends to increase in accordance with the increase of potential on the grid.

The total drop of potential in the output circuit is made up of two parts, that across the tube between the anode and cathode and that across the resistance 50.

If now the current is increased, not by increasing the electromotive force of the battery or source 55, but by increasing the potential difference

between the cathode and the grid, the current through the resistance 58 increases. Since the output source 65 remains constant, it follows that the drop of potential across the tube decreases while that across the resistances 58 increases. A choking effect is thus produced by the resistance 58 with the result that, as the grid potential becomes greater, more and more current is diverted to the grid. A point is finally reached where no measurable increase in anode-cathode current is produced by increasing the grid potential. If the maximum amount of current is made approximately equal to the current required to transmit the talk, the interfering sounds, due to accidental causes, cannot possibly be of greater intensity than the speech.

Rewrite claims 5, 6, 7, 8, and 9 as follows:

5. A receiving system comprising two electron discharge devices, each of said devices including an impedance controlling element, individual input circuits and individual output circuits for said devices, a portion of the similar circuits of said devices being in common, and a high impedance in the said common portion.

6. In a receiving system for radio signaling, a power limiting device comprising separated elements, an impedance controlling means for controlling the impedance of the space between said elements, said device having input and output circuits, a source of current for said output circuit, and regu-

lating means in the output circuit for causing the current supplied by said source to approach a maximum value as the input voltage is increased.

7. In a receiving system for radio signaling, a power limiting device comprising separated electrodes, an impedance controlling means for controlling the impedance between said electrodes, said device having input and output circuits, a source of power for said output circuit, and means responsive to the current in said output circuit for controlling the potential applied from said source across said electrodes whereby the rise of currents in said output circuit is limited.

8. In a receiving system for radio signaling, a power limiting device comprising an electron discharge element, an input circuit and an output circuit for said element, said output circuit having a portion which is traversed by fluctuating current passed by said element, and a high resistance in said portion.

9. In a receiving system for radio signaling a power limiting device comprising an electron discharge element, an input circuit and an output circuit having a portion which is traversed by fluctuating current passed by said element, a source of current for said output circuit, and a high resistance in said portion serially connected with said source for limiting the rise of current in said output circuit.

Claim 18, line 2, cancel "one or more" and insert as follows --such--.

Claim 16, line 3, cancel "one or more"; line 4, cancel "of one or more".

Claim 22, line 5, after "resistance" insert --so located--; after "circuit" insert --and--.

Claim 23, line 6, after "values" insert --and said resistance being so located in said output circuit--.

Add the following claims:

24. A system for repeating alternating current comprising a plurality of electron discharge devices, an impedance varying element for one of said devices, a source of space currents for said devices, means tending to maintain the sum of the space currents through said devices constant, and means for utilising the repeated alternating current.

25. A system for amplifying alternating or fluctuating current energy comprising two electrical discharge devices, input and output circuits therefor, said devices being symmetrically and oppositely disposed with respect to each of said circuits, and space current paths for said devices, said paths having a common portion external to said devices and of high impedance to currents of the frequencies to be amplified.

26. A receiving system comprising an electron discharge element, an input circuit and an output circuit for said element, said output circuit having a portion through which the fluctuating component of the current in said output circuit passes, said portion being of relatively high impedance to the fluctuating component.

Serial No. 48,873---5.

27. An amplifier comprising two electron discharge devices, an electron emitting cathode and an anode for said devices, space current circuits for said devices, said circuits having a common portion and individual portions, and a high impedance in said common portion.

28. In combination, a plurality of electron discharge devices, one of said devices having an impedance varying element, a source of space currents associated with said devices so as to constantly maintain an unidirectional potential across said devices, and means tending to maintain the sum of the space currents through said devices constant.

29. In combination, a source of current, a plurality of electron discharge devices having space current paths, said paths being similarly connected to said source, one of said devices having an impedance varying element, and means tending to maintain the sum of the space currents through said devices constant.

REMARKS

A revision of the theoretical explanation at the end of the specification has been made to make the disclosure more clear.

The Examiner's objection to the use of the word "including" in claim 4, line 2, is not well founded. The primary meaning of the word "including" as given in the Standard Dictionary is "to confine within something; hold

as within an enclosure; enclose; contain".

Claims 5, 6 and 7 have been rewritten to correct informalities, but without substantial change of subject matter.

Claims 8, 9, 22 and 23 have been amended to distinguish from the patent to Arnold, 1,114,845. In that patent, it will be noted that the condenser 9 is in shunt to the resistance 8 and as pointed out in the specification, at lines 64 to 66, this condenser is of such value that the alternating or fluctuating component of the current passes therethrough. It will, therefore, be apparent that the patented arrangement could not function efficiently to limit alternating current energies of frequencies as high or higher than those which the device is adapted to repeat. Owing to the capacity of the condenser 9, a brief rise of current of large magnitude can take place. In the present arrangement, a high resistance or inductive impedance such as 58, prevents any such large increases of current. The patented arrangement was not intended to limit the alternating current but only to eliminate blue haze in case this abnormal condition occurred. When blue haze occurs, the output current assumes a permanently increased value until the blue haze is stopped. The present invention is operative to perform its intended function in case the vacuum tube is so highly exhausted that no blue haze will occur, even at the highest impressed potentials. While the present arrangement may perform the function of the patented arrangement, it is obvious that an additional and novel function is also performed. It is believed that amended claims 8, 9, 22 and 23 and added claim 26 definitely define the means which distinguish the present invention from applicant's prior patent 1,114,845.

Serial No. 48,873---7.

Claims 15 and 16 have been amended to remove informalities and to distinguish from the direct current transformer system of Langmuir's patent 1,275,826. Certain new claims to somewhat similar subject matter have been added and distinguish from this patent in various particulars. It will be noted that applicant's system differs in numerous fundamental respects from that of Langmuir, one of which is that while applicant desires small or negligible change of current through impedance 58, Langmuir's system will not function efficiently unless considerable changes of current take place in the inductance 5 as it is only by virtue of such changes that substantial amounts of energy can be stored in the inductance 5 and thence given out to circuit 12-13.

The Examiner's reference to Commissioner's order 2210 is noted and the utmost care consistent with obtaining adequate protection has been made to place the application in condition for final action.

It is believed that all the claims are patentable over each and every reference of record considered either singly or in combination and that the application is in condition for allowance, hence such action is requested.

Respectfully,

HAROLD D. ARNOLD,

By J. R. Roberts
Attorney.

920 Broadway,

New York, New York, June 4, 1919.

JWR-LM-UR

D.r. 16 Rev. 112 — 2-300

Address The Commissioner of Patents, Washington, D. C., and not any official by name.

LBG

Paper No. 12

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Nov. 3, 1919

Mr. John C. Roberts,

463 West St.,

New York, N.Y.

U.S. PATENT OFFICE NOV 3 1919 FILED

Please find below a communication from the EXAMINER in charge of the application of

Harold D. Arnold. Ser. #48,873, filed Sept. 2, 1915.

Power Limiting Amplifying Devices.

James T. Newton

Commissioner of Patents.

This action is in reply to amendment filed June 5, 1919.

Claims 15 and 16 are rejected on patent to Langmuir. Either or both of Langmuir's devices 5, 14 might have a grid electrode without invention. It is common to use the three-electrode valve as a two-electrode valve if desired, merely leaving the grid unconnected. There are no elements set forth in these claims to indicate any cooperative relation whatever between the grids or impedance control elements and the remaining elements set forth in the claims.

Claims 22 and 23 are rejected on patent to Arnold, 1,114,845, of record. The amendments to these claims are merely functional statements, and all the structure set forth in the claims is found in the patent to Arnold. If applicant's device obtains a result not obtained by Arnold, it must be because of a different construction not found in Arnold, in which case the difference in the structure itself should be set forth in the claims.

Claim 28 is rejected on Langmuir of record. The direct current source constantly maintains a unidirectional potential across both the devices 5 and 14 and the inductance 3 tends to maintain the sum of the space currents constant.

Ser. 748,873.

As a clear issue has been reached in this case and the application has been pending for over four years, this action is made final. However, the examiner will admit any amendment which will enable him to pass the case for issue.

H.S.M

Examiner, Div. 16.

1037

Case 16

PAPER NO 14
AMENDMENT

APPLICATION DIV. NOV 3 1920 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 112

In re application of HAROLD D. ARNOLD	Subject.
Serial No. 48,873	Radio Communication
Filed September 3, 1915	

1920 NOV

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of November 3, 1919, please amend the above-entitled application as follows:

Claim 15, line 3, after "element" and before the comma, insert --for influencing the space current flow therethrough in accordance with waves impressed thereon,--; line 4, cancel "therefor" and substitute --for said devices--.

Claim 16, lines 3 and 4, cancel "elements for varying the impedance of said spaces respectively" and substitute --means including impedance varying elements for causing the impedance of said spaces to vary differently at different instants--.

Cancel claim 22 and substitute the following as claim 22:

--22. In a signaling system, a power limiting device comprising an electron discharge device having an input circuit and an output circuit, a source of variable current connected to said input circuit, a path in said output circuit through which amplified variations from said source are constrained to pass, and a resistance located in said path

of such a value that waves of a normal value from said source will produce desired variations of current through said path, but impulses of a greater voltage will produce current having a maximum value not materially greater than the maximum value of current produced by waves of normal voltage applied to said input circuit.

Cancel claim 23 and substitute the following as claim 23:

E4

23. In a signaling system, a power limiting device comprising an electron discharge device having input and output circuits, a source of space current for said output circuit, a path in said output circuit through which alternating current components are constrained to flow and a resistance in said path, said source and said resistance being of such values that incoming signal waves will produce desired changes of current, but incoming waves of greater strength will produce only negligibly larger changes of current through said path.

Add the following as claims 29 and 30:

E5

29. The method of overcoming the effects of static disturbances in a wireless signaling system which consists in producing at a receiving station by means of the signaling current an alternating current having a frequency much lower than the transmitted radio frequency current, and passing this current through a circuit containing a device for limiting the energy passing therethrough to a predetermined value.

30. The method of overcoming the effects of static disturbances in a wireless telephone receiving system which consists in first detecting the received signaling waves, thereby producing a varying current having a fre-

quency much lower than the received waves; passing this current through a circuit containing a device for limiting the energy passing therethrough to a predetermined value and reproducing the telephone signal by the current passed through said circuit.

Cancel claim 21 and change the numeral of claim 22 to 21.

R E M A R K S

Claims 15 and 16 have been amended to indicate a cooperative relation between the grids and the remaining elements set forth in the claims. This relation consists in the fact that means are provided whereby although the grids vary the impedance of the two spaces, nevertheless, the sum of currents therethrough is maintained at a constant value. Furthermore, claim 16 is limited to the case where the grids or control elements cause different variations in the impedance of the two spaces at different instants.

Claims 22 and 23 have been amended to distinguish from Arnold by pointing out that the current limiting resistance is in the part of the plate current circuit through which the alternating component of the plate current is constrained to flow. In each of the modifications disclosed by Arnold, the resistance is in the direct current path of the output circuit, but has a shunt path therearound traversable by alternating current through which the alternating component flows. In the case of impulsive disturbances large increases of current can occur in the shunt path for short periods of time. These would tend to cause disturbances which the present arrangement is designed to prohibit. Furthermore, it should be pointed

out that in a radio system sudden disturbances of short duration are likely to be caused by static.

Claims 29 and 30 which have been added are believed to define novel subject-matter patentable to applicant. These claims cover the method of static reduction which consists in first detecting or otherwise reducing the frequency of the incoming signaling wave and thereafter passing the resulting alternating current through a power limiting device. Claim 29 corresponds to the claim 25 which is under final rejection in the application of Alexanderson, Serial No. 92,156, filed April 19, 1916. Applicant has recently had access to this application as a result of an interference. This claim is rejected in Alexanderson's application on British patent 8,373 of 1915 in view of Hammond 1,274,344. It is noted that Arnold's filing date is prior to the publication of the British patent which is no reference against Arnold's claims 29 and 30 for this reason.

This amendment is made with the understanding that it will be entered and considered by the Examiner in accordance with the understanding had at a recent oral interview.

It is believed that the application is in condition for allowance, which action is respectfully requested.

Respectfully,

HAROLD D. ARNOLD

By C. A. Hague
Attorney.

463 West Street,
New York, Oct. 22, 1920.

JWB:H

64/49

1941

Letter No. 15

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON March 14, 1921

The Hon. Commissioner of Patents,

Sir:

It is requested that the application of H. D. ARNOLD, Serial No. 48,875, filed Sept. 3, 1915, for Power Limiting Amplifying Devices, be withdrawn from issue for the purpose of including it in interference, declaration of which was approved by the Law Examiner on March 7, 1921.

Respectfully,

H. D. Arnold

H.D.M.

Exr., Div. 16.

Approved.

MAR 17 1921

W. W. Coulston

Asst. Commissioner of Patents.

CASE WITHDRAWN FROM FILE OF ISSUE AND GAZETTE DIVISION
at 10 a.m. MAR 15 1921

1042

"A"

INTERFERENCE.

Interference No. 45944 *Paper No.* 16

Name Harold D. Arnold.

Serial No. 48873.

Title, Power Limiting Amplifying Devices.

Filed, Sept. 3, 1918

Interference with E. F. W. Alexanderson

DECISIONS OF

Primary Examiner, _____ *Dated,* _____

Ex'r of Interferences, Favorable *Dated,* Dec. 24/24.

Board, _____ *Dated,* _____

Commissioner, _____ *Dated,* _____

REMARKS:

This should be placed in each application or patent involved in interference in addition to the interference letter by Primary Examiner.

1643

Forwarded from 16 Div. to Examiner of Interferences. LEG [illegible] Paper No. 17 (Interference)

Apr. 27, 1921

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE. "A"
WASHINGTON, D. C.

Mr. John G. Roberts,
463 West St.,
New York, N. Y.

U S PATENT OFFICE
MAY 5 1921
MAILED

Please find below a copy of a communication from the Examiner concerning the Harold D. Arnold. Ser. 48,673. Filed Sept. 5, 1915.
Power Limiting Amplifying Devices.

Room No.

ADDRESS ONLY THE COMMISSIONER OF PATENTS WASHINGTON, D. C.

Very respectfully, THOS. E. ROBERTSON
Commissioner of Patents.

45944

The case, above referred to, is adjudged to interfere with others, hereafter specified, and the question of priority will be determined in conformity with the Rules.

The statement demanded by Rule 110 must be sealed up and filed on or before MAY 31 1921 with the subject of the invention, and name of party filing it, indorsed on the envelope. The subject-matter involved in the interference is

1. The method of overcoming the effects of static disturbances in a wireless signaling system, which consists in producing at a receiving station by means of the signaling current having a frequency much lower than the transmitted radio frequency current, and passing this current through a circuit containing a device for limiting the energy passing therethrough to a predetermined value.

The interference involves your application above identified; and

An application for Wireless Signaling Systems, filed by Ernst F. W. Alexanderson, of General Electric Company, Schenectady, N. Y., whose attorney is Albert G. Davis, of Schenectady, N. Y., and whose assignee is General Electric Company, a corporation of New York.

The count of the interference is claim 25 of ALEXANDERSON and claim 29 of ARNOLD.

H.S.M.

Asst. Div. 16

1044

Case 16
PAPER NO. 18
AMENDMENT.

UNITED STATES PATENT OFFICE.

Division 16 Room 112 (R.78-Not entered

MAIL ROOM JUN 28 1922 U.S. PATENT OFFICE

In re application of

HAROLD D. ARNOLD

Subject.

RADIO COMMUNICATION

Serial No. 48,875

Filed September 5, 1915
Allowed February 9, 1922.
Final fee not paid.

PATENT OFFICE JUN 28 1922 REC'D FILED

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Applicant respectfully petitions entry of the following amendment under the provisions of Rule 78 without withdrawing the application from issue.

Page 2, line 6, change "Its" to --In--.

Page 3, lines 5 to 7, cancel "being essential to the operation of the device for the purpose specified by preventing unbalanced currents in the two halves of the device " and substitute therefor --performing an important function in connection with the power or current limiting action of the device as hereinafter described--.

Page 4, line 18, after "leak" insert --which is--; line 25, cancel "rectifier" and substitute --detector--.

Please add the following claims:

--31. The method of reducing detrimental effects of disturbing waves superimposed on waves to be received at a receiving station which comprises utilizing the energy of the received waves to produce a current which varies in amplitude at a frequency widely different from that of the received waves, and passing this current through a circuit containing a

device for limiting the energy passing therethrough to a predetermined value.

32. A system for reducing the detrimental effects of disturbing waves superimposed on waves to be received which comprises devices for producing at a receiving station by means of the received waves an alternating current of a widely different frequency from that of the received waves, a circuit through which the alternating current is to be passed, and means for limiting to a predetermined value the energy passing through said circuit.

33. In an electric system, an incoming circuit and a plural stage amplifier for amplifying signals from said circuit, the last stage of said amplifier comprising two vacuum tube repeaters connected in push-pull relation, and another of said stages comprising only a single vacuum tube repeater.

34. In an electric system, a plural stage amplifier for amplifying signals adapted to be connected to an incoming circuit from which the signals are received, the last stage of said amplifier comprising two vacuum tube repeaters connected in push-pull relation, another of said stages comprising only a single vacuum tube repeater, a receiving device, and a transformer for coupling said device to the output circuit of said last stage.

35. A high frequency receiving system comprising means for detecting high frequency received oscillations, a receiving device for translating electric waves into energy of a different form, and a plural stage repeater between said detecting means and said device for impressing on said device the detected currents in an amplified form, said plural stage repeater comprising a push-pull vacuum tube repeater in only the last stage thereof.

36. An amplifier circuit for electric wave energy comprising an amplifying stage consisting of a simple vacuum tube repeater working into a push-pull vacuum tube repeater, the push-pull repeater consisting of tubes having their grid circuits oppositely coupled to the output circuit of the simple vacuum tube repeater.

37. An amplifier circuit for electric wave energy of speech frequencies comprising an amplifying stage consisting of a single vacuum tube repeater working into a push-pull vacuum tube repeater, the push-pull repeater consisting of two tubes having their grid circuits oppositely coupled to the output circuit of the single vacuum tube repeater. --

R E M A R K S

Proposed claims 36 and 37 are along the line of claims 29 and 30, the former of which constituted the count of interference No. 65,944, in which applicant was awarded priority. The proposed claims are broader than claim 29 in that they are not limited to reducing the frequency of received waves and then

limiting their amplitude but are broad enough to cover increasing by a substantial amount the frequency of the received waves and then limiting the current representing the waves of increased frequency. Apparently, applicant is the first to change the frequency of received waves before limiting the power transferred to a signaling instrument and is entitled to broad claims on this subject matter. The prior art has been carefully considered in connection with the present application and it is believed that the Examiner is so familiar with the art that, notwithstanding the fact that these claims are somewhat broader, they will be found allowable without a new search.

The proposed claims 55 to 57, inclusive, present a novel feature of the invention considered by applicant to have been heretofore insufficiently claimed. These claims are intended to more definitely cover that feature of applicant's invention which may be described in general terms as an amplifier circuit consisting of one or more stages of simple thermionic amplifiers, that is single tubes or a plurality of tubes in parallel in each stage, feeding into one or more succeeding stages consisting of tubes arranged in push-pull relation. It is very advantageous in many instances to use such an arrangement. Relatively small currents transversing the first stages are transmitted in amplified form to the last stage or stages with but small distortion. Simple repeaters in the final stages would largely distort the amplified waves but by making use of tubes in push-pull relation an amplified output of much greater amplitude can be secured with but small distortion. This results from the fact that the use of tubes

in push-pull relation permits of working over a much greater portion of the tube characteristic and, consequently, over a considerable part of the more curved portions with less resultant distortion. For example, if speech currents are to be amplified by the use of not more than three similar tubes, much greater gains can be secured by the use of one tube working into a push-pull arrangement of two tubes than by any other possible circuit employing the same tubes. This permits of much more efficient utilization of the tubes. In other cases not limited to the use of any particular number or design of tubes, the same general principles hold true in that greater amplified currents can be produced in general by using a push-pull repeater in the last stage or stages only of a plural stage amplifier circuit.

Applicant is believed to be the first to employ such an arrangement and, inasmuch as all pertinent references are considered to be of record in this amplification, none of them anticipating the proposed claims, it is considered that the Examiner will be able to recommend the entry and allowance of these claims without a new search.

Favorable action upon the present petition is requested.

Respectfully,

HAROLD D. ARNOLD,

By H. E. Ofeldt
Attorney.

463 West Street,
New York, June 27, 1922.

JWS-I

UNITED STATES PATENT OFFICE

In re application of
HAROLD D. ARNOLD
Serial No. 48,873 — Subject: Radio Communication.
Filed September 5, 1915
Allowed February 9, 1922.

PATENT OFFICE JUN 23 1922

AFFIDAVIT UNDER RULE 48.

State of New York } ss.
County of New York }

HAROLD D. ARNOLD, being duly sworn, deposes and says:

That he is the person who executed the papers in the above entitled application;

That the subject matter of the present amendment and the amendments filed September 1, 1916, May 9, 1917, June 13, 1918, June 5, 1919 and November 3, 1920, was a part of his invention, was invented before he filed his original application above identified, for such invention, was not known or used before his invention, was not patented or described in a printed publication in any country more than two years before his application, was not patented in any foreign country on an application filed by himself or his legal representatives or assigns more than twelve months prior to his application, was not in public use or on sale in this country for more than two years before the date of his application, and has not been abandoned.

Harold D. Arnold

Sworn to and subscribed before me
this 27th day of June, 1922.

Notary Public.

NOTARY PUBLIC, Queens County
Queens County Clerk's No. 1174
Certificate filed in New York County
Clerk's No. [illegible]
Commission Expires March 30th, 1924

JWS:I

1050

Div. 16 Room 112 CND/HBM Paper No. 19

[redacted] 2-261-b

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

June 30, 1922.

Mr. John G. Roberts,
463 West Street,
New York, New York.

In the application of Harold de Forest Arnold, 48,873, filed Sept. 8, 1915, for Power Limiting Amplifying Devices, allowed Feb. 9, 1922.

The entry of the amendment proposed under Rule 78 has been disapproved. A copy of the examiner's adverse report appears below.

James E. Robertson
Commissioner of Patents.

Applicant petitions that a proposed amendment be entered under Rule 78 in this application in which the final fee has not been paid.

It is recommended that the proposed amendment be not entered for the reasons hereinafter set forth.

The proposed changes to the specification appear to be permissible.

Proposed claims numbered 31 and 32 are considered allowable.

Proposed claims 33, 34 and 36 are considered unpatentable for the reason that no invention is required to use for the last stage of amplification in a plural stage amplifying system such as shown by either of the patents to

Alexanderson, 1,175,079, Feb. 22, 1916, 250-20,
de Forest, British, 2,069 of 1914, 1 sheet, 250-27,

an amplifier of the push-pull type as shown by COLPITTS, 1,128,292, of record, or Fig. 3 of ALEXANDERSON, cited.

Claim 37 is considered unpatentable for the same reasons,

for although the claim specifies speech frequencies, de Forest and Colpitts show amplifiers for such frequencies, and this claim does not, by the elements enumerated, set forth anything different from claim 56.

Claim 35 is considered unpatentable for the reason that no invention is required to substitute for the amplifier a' of Fig. 3 of patent to Schlomilch et al., of record, another type of amplifier not involving invention, such as specified in claim 33. There appears to be no novel cooperative relation between the specific form of amplifier and the remaining features set forth.

For these reasons the Examiner's recommendation is adverse.

R.J.M.

Examiner, Division 16.

APPROVED

JUN 30 1922

1052

Case 16

PAPER NO 21

AMENDMENT B

(R 78- Not Entered)

UNITED STATES PATENT OFFICE

Division 16 Room 118

ISSUE DIVISION

JUL 31 1922

U S PATENT OFFICE

In re application of

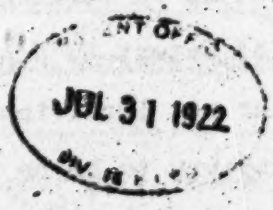
HAROLD D. ARNOLD

Serial No. 48,875

Filed September 3, 1915
Allowed February 9, 1922

Subject.

Radio Communication.



THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Applicant respectfully petitions entry of the following amendment under the provisions of Rule 78 without withdrawing the application from issue.

Please add the following claim:

---58. In an amplifying apparatus for wireless signals and the like, a plurality of thermionic relays comprising each an evacuated bulb, a plate, a filament and a grid in said bulb, transformers having one of their windings in circuit with the filament and grid of each of said lamps respectively, the other winding of one of said transformers being adapted to be connected to a source of potential, a common source of current in circuit with the plate and filament of each of said relays, and a connection between said source of current and the transformer winding adapted to be connected to a source of potential.---

R E M A R K S

The claim presented herewith is claim 11 of patent No. 1,405,525 to Marius Latour granted February 7, 1922.

An oath under Rule 48 is filed herewith in reference to the above claim.

Respectfully,

HAROLD D. ARNOLD,

By E. W. Bruce
Attorney.

463 West Street,

New York, July 25th, 1922.

MJ3:QE

#21

APPLICATION FILED JUL 29 1922 PATENT OFFICE

Case 16

UNITED STATES PATENT OFFICE

Division 16 Room 118

In the matter of the application of HAROLD D. ARNOLD Serial No. 48,878 Filed September 5, 1915	Radio Communication.

AFFIDAVIT

JUL 31 1922

State of New York } ss.
County of New York }

I, JOSEPH P. MAXFIELD, being duly sworn, depose and say as follows:

I have been in the employ of the Western Electric Company, Incorporated, continuously from July 1914 down to the present. Both before coming into the employ of said company and continuously during such period of employment I have been engaged in studies and researches relating to acoustics. From the beginning of the year 1919 down to the present I have been working on the development of high quality loud speaker apparatus and on phonographic recording.

I personally have participated in and supervised extensive tests of volume and quality of transmission. Incidental to those tests and to the development of loud speaker apparatus I have been engaged in studies of different types of vacuum tube amplifier circuits.

I am familiar with telephone repeaters and with the requirements put upon them as regards amplification, power output and quality of transmission. The vacuum tube amplifier circuits that have been developed for use as telephone repeaters are wholly inadequate for use as amplifiers for high-power, loud speaker apparatus and in the development of loud speakers

to their present state of proficiency it was found necessary to adopt amplifiers to meet requirements as to volume and quality of transmission far beyond those placed upon commercial telephone transmission circuits. As examples of the higher standard to be met in loud speaker apparatus a frequency range of from about 60 cycles to about 5,000 cycles is employed, and in many instances a power output of the order of five watts or more is required from the amplifiers in typical loud speaker apparatus; whereas in commercial telephone transmission a frequency range of only about 200 to 2,500 cycles and a power output from the repeater of only the order of 1/20 watt has frequently been provided for. Whereas in telephone repeaters a single stage of amplification is often all that is necessary and two stages of amplification employing a single tube in each stage is ample for practically any situation, in loud speaker apparatus in order to provide the requisite power output a multi-stage amplifier is practically always necessary. The tests above referred to were for the purpose of comparing different types of amplifier circuits including a type of tube arrangement such as is shown in United States application Serial No. 48,875 of Harold D. Arnold, filed September 3, 1915 to determine the type of circuit capable of giving the greatest amplification with the highest quality of transmission and maximum power output, coupled with an economy of apparatus.

In any multi-stage circuit which, as a whole, is to meet these requirements each stage must have an arrangement and operating characteristics suited to the particular duties which it has to perform by itself and in cooperation with the rest of the circuit. Maximum power output a re-

64/64

quirement particularly of the last stage, with highest quality for any type of tube is obtained by arranging two tubes in balanced, that is, push-pull, relation. Two tubes in a balanced push-pull circuit give high quality even when made to operate over the portion of their static characteristics having a square-law curvature and probably into the initial portion of the range, at least, which begins to obey the cubic law, and in the other direction along the characteristic, up to the point where the grid begins to go positive. For the same quality of output it has been determined that with the type of tube and push-pull circuit used in the No. 2 Public Address systems of the Western Electric Company, Incorporated, the push-pull stage has a power output of the order of 10 times that of one of the tubes alone and of the order of five times the power output of the same two tubes connected in a simple parallel relation. This is on the basis of the same power supply to the tubes in all three instances. It follows that for the same quality of output that is obtained with two tubes of the order of five watts rating, for example, used in push-pull relation, a single tube to give the same power output would need to be of a rating of at least several times 10 watts.

In the stage immediately preceding and working into the push-pull stage it is found that a single tube of the same type and rating as either of the tubes in the push-pull stage [illegible] much [illegible] than is necessary to work the push-pull stage at its high output load and without the single tube introducing distortion beyond the high quality standard set for the entire circuit. To use a push-pull circuit for this stage identical with the succeeding stage would be poor economy since the extra tube not only would contribute no advantage but would

44/65

actually be a detriment on account of the double chance of burning out a tube and causing the circuit to fail at a critical moment. Added to the cost of the extra tube would be the balanced transformers and greater filament heating and plate current energy necessary for the push-pull circuit.

In general it may be stated that if three tubes of the same type and rating are to be used, the one type of connection which gives the greatest amplification with the greatest output energy and minimum distortion is the connection in which one of the tubes works into the other two in push-pull relation.

In all of the high-power high-quality public address systems of my acquaintance which have been developed by the Western Electric Company, Incorporated, many of which have been demonstrated on notable occasions and with high success, the amplifier circuits employed a single amplifier tube working into a push-pull circuit.

While the circuit consisting of a single tube feeding into two tubes arranged in push-pull relation would in my opinion have the same inherent advantages in a variety of uses as those which have been pointed out in connection with loud speakers, I have confined my discussion of it to use in loud speaking apparatus both because I am more especially familiar with its advantages and importance in such apparatus, and because the same or similar considerations as have been pointed out herein would apply in other relations, and the statements made, although with reference to

a specific type of apparatus may serve as examples.

Joseph P. Maffield.

Sworn to and subscribed before
me this 28th day of July 1928.

Notary Public.

NOTARY PUBLIC, Queens County
Queens County Clerk's No. 1256
Certificate filed in New York County
Clerk's No. 186; Register's No. 4256
Commission Expires March 30th, 1929

HAB:GZ

Case 1059

PAPER NO. 22
AMENDMENT H

UNITED STATES PATENT OFFICE.

(R. 78 - 1st Entered)

Division 16 Room 118

P

AUG 1 1922 U.S. PATENT OFFICE

In re application of HAROLD D. ARNOLD

Subject. RADIO COMMUNICATION.

Serial No. 48,875

Filed September 8, 1915
Allowed February 9, 1922.

PATENT OFFICE ISSUE DIVISION
AUG 2 - 1922 AUG 2 1922
U. S. PATENT OFFICE.

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Applicant respectfully petitions entry of the following amendment under the provisions of Rule 78 without withdrawing the application from issue.

Page 2, line 6, change "Its" to --An--.

Page 3, lines 5 to 7, cancel "being essential to the operation of the device for the purpose specified by preventing unbalanced currents in the two halves of the device" and substitute therefor --performing an important function in connection with the power or current limiting action of the device as hereinafter described--.

Page 4, line 18, after "leak" insert --which is--; line 25, cancel "rectifier" and substitute --detector--.

Please add the following claims;

--31. The method of reducing detrimental effects of disturbing waves superimposed on waves to be received at a receiving station which comprises utilizing the energy of the received waves to produce a current which varies in amplitude at a frequency widely different from that of the received waves, and passing this current through a circuit containing a

device for limiting the energy passing therethrough to a predetermined value.

33. A system for reducing the detrimental effects of disturbing waves superimposed on waves to be received which comprises devices for producing at a receiving station by means of the received waves an alternating current of a widely different frequency from that of the received waves, a circuit through which the alternating current is to be passed, and means for limiting to a predetermined value the energy passing through said circuit.

35. In an electric system, an incoming circuit and a plural stage amplifier for amplifying signals from said circuit comprising in one stage of said amplifier two vacuum tube repeaters connected in push-pull relation, and at least one stage consisting of a single vacuum tube amplifier feeding into said push-pull stage.

34. In a plural-stage amplifier circuit in which the amplitude of the repeated current increases in succeeding stages, at least one preliminary stage consisting of a single tube amplifier for amplifying the repeated wave up to a given current amplitude and a succeeding stage consisting of a pair of vacuum tube amplifiers connected in push-pull relation for amplifying the repeated wave up to a much larger current amplitude.

35. In a plural stage amplifier circuit for amplifying signal currents, employing vacuum tube amplifiers in which, for relatively strong output currents at least, as the amplitude of the repeated wave becomes larger the distortion of the wave increases, said amplifier circuit comprising at least one stage consisting of a single vacuum tube repeater operating over a relatively small current amplitude range and giving amplification with the required degree of faithfulness of repetition of the signal and a stage into which said single tube stage feeds, for amplifying the repeated wave up to a current amplitude at which undesired distortion would take place in a single one of said tubes used alone, said later stage comprising a pair of vacuum tube repeaters connected in push-pull relation, whereby at said large current amplitude a faithfulness of repetition is obtained consistent with that of the preceding stage.

36. In combination, three electron discharge tubes, means for supplying discharge current to said tubes, two of said tubes being connected in push-pull relation, the other one of said tubes being arranged to impress amplified signal waves on said push-pull connected tubes of such amplitude that at the peak amplitude of said waves, for a given half-cycle the resultant momentary decrease in the normal discharge current

through one of said push-pull connected tubes reduces the discharge current through said tube near to zero.

57. In combination a pair of space discharge devices, each of said devices having a cathode, an anode and a grid or control element, anode circuits and grid circuits for said devices, a common source of discharge current connected to said anodes, a common source of alternating current potential connected to said grids, said devices being connected to operate in push-pull relation, the normal discharge current through said tubes being so related to the amplitude of the alternating potential impressed on said grids that at the peak amplitude of said alternating potential the space current through one and the other of said devices alternately is reduced substantially to zero.

59. In an electric system, an incoming circuit and a plural stage amplifier for amplifying signals from said circuit, said amplifier comprising at least one stage consisting of a single electron discharge tube and a stage consisting of a pair of electron discharge tubes connected in push-pull relation, having their input sides connected to the output side of said first mentioned stage, means for supplying discharge current to said tubes, the amplitude

of the signal variations in the discharge current of said push-pull tubes being of the order of magnitude of the normal discharge current through said tubes.

40. A high-frequency receiving system comprising means for detecting high frequency received oscillations, a receiving device for translating electric waves into energy of a different form, and a plural stage repeater between said detecting means and said device for impressing on said device the detected currents in an amplified form, said plural stage repeater comprising at least one stage consisting of a single vacuum tube amplifier, the final stage consisting of a push-pull vacuum tube repeater.--

R E M A R K S

Claims 31 and 32 presented herewith are similarly numbered claims of the amendment of June 27, 1928, petitioned entry under Rule 78, which claims were indicated as allowable in the Office letter of June 30, 1928.

Claim 33 is presented in accordance with the suggestion of the Examiner in a recent interview, and claims 34 to 37 and 39 are drawn along lines discussed at the interview. Claim 40 is modeled after claim 35 of the amendment of June 27, 1928, but is more specific.

The Examiner is respectfully referred to the affidavit of Joseph P. Manfield filed July 29, 1922, for the statements contained therein as to the very significant, valuable and not-to-be-expected results obtained from the combination of a single tube amplifier feeding into a push-pull circuit. Reference is made also to the remarks at the end of the amendment of June 27, 1922.

Consideration of these statements, as was pointed out in the recent oral interview with the Examiner will make it evident that the one way to associate three amplifiers to secure the greatest amplification with the greatest power output and minimum of distortion is by arranging one of the tubes to feed into the other two in push-pull relation. The remarkably high efficiency of such a circuit comes from the fact that the push-pull circuit can be loaded to work over the curved part of the tube characteristic to a considerable extent and still give high quality, and from the further fact that a single tube is amply sufficient to supply the power necessary to load the push-pull tubes to this extent. For quantitative comparisons and a more complete explanation, the affidavit and the remarks above identified are referred to.

It is submitted that claim 58, to a specific combination from which striking new results are obtained as explained in the interview with the Examiner and as attested by Manfield's affidavit, is not anticipated by ideas found in Alexanderson 1,173,079 or British 2,059-1914 or Colpitts 1,128,292, all of record. This combination is specific to the arrangement in which the single

tube precedes and feeds into the push-pull stage. It is only from this particular arrangement that the particularly advantageous results flow, - namely, greatest amplification with greatest power output at highest quality.

It is respectfully pointed out that there is no suggestion in Colpitts 1,128,892 of using a push-pull circuit in a multi-stage amplifier. Page 1, lines 16 and 17 and 20 to 25 of the Colpitts specification, together with the entire description, would, it is submitted, rather suggest that the results aimed at in the patent are attained in a repeater consisting merely of a single push-pull circuit. If for any reason one should desire to use two stages, and secure the improved quality which this patent sets forth as attained by the push-pull circuits, it would be obvious to use the push-pull circuit in both stages, but it would be most illogical and unexpected that one should, in the light of this patent, use a single tube amplifier in one stage and a push-pull circuit in another. And if one were even to use a push-pull in one stage and a single tube in another it would seem quite fortuitous for one to place the single tube ahead of the push-pull stage. If it is to be presumed that the amplifiers are to be placed in this specific arrangement some reason must be attributed for so doing, and it is respectfully submitted that this reason must come from somewhere besides anything contained in the patents of record. In other words this combination results from

an idea not found in the patents of record and which, it is believed, could not be supplied by these patents. It remained for applicant to hit upon and disclose this simple but exceedingly valuable combination. Since this claim defines the exact arrangement of tubes from which the surprising results referred to are obtained, in that it is specific to the push-pull succeeding the single tube amplifier, it is respectfully urged that the claim accurately and sufficiently defines a novel combination which of itself gives results not to be expected, and that the claim is patentable.

Claim 34 is drawn from a somewhat different point of view and is believed clearly patentable for the same reasons as pointed out in connection with claim 35.

In connection with claim 36 it is respectfully pointed out that on the last page of applicant's specification the signal variations in the current through one of the push-pull tubes are described as approximately equal to those simultaneously taking place in the current through the other, and that these variations can be nearly as great as the normal space current - assumptions which are amply justified in view of measurements taken with a circuit of this type. These conditions enable the high-power high-quality output called for in claim 36 to be attained in the push-pull stage. Current variations of this amplitude in a single tube of the same rating, if they were possible, would be badly distorted.

Claims 36, 37, and 39 include quantitative relations clearly not found in the art but relations which characterize the invention and lead to the valuable results

referred to above.

Claim 40 sets out a combination in which the final stage of a plural-stage amplifier in a radio receiving system comprises a push-pull circuit. Such a circuit enables high-amplification of the relatively weak received signals and large power output with minimum distortion - all of which are essential factors particularly in a receiving system in which the receiving instrument requires considerable power as is frequently the case.

The claims as presented are believed clearly allowable.

Entry of this amendment is respectfully petitioned.

Respectfully,

HAROLD D. ARNOLD,

By [signature]
Attorney.

463 West Street,
New York, Aug. 1, 1922.

HAB:QE

1068

Div. 16 Room 112 HSH:LBG 2,561-b Paper No. 25

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

August 7, 1922

Mr. John C. Roberts,
463 West St.,
New York, N. Y.

In the application of Ser. #48,873, filed Sept. 3, 1915, by Harold D. Arnold, Allowed Feb. 9, 1922.

Power Limiting Amplifying Devices.

The entry of the amendment proposed under Rule 78 has been disapproved. A copy of the examiner's adverse report appears below.

Thomas E. Robertson
Commissioner of Patents.

Two amendments containing proposed claims 31 to 40 were filed July 29 and Aug. 2, 1922, respectively, in this application in which the final fee has not been paid. It is recommended that these amendments be not entered for the following reasons:

Claim 35 is considered unpatentable for the reasons set forth in the Examiner's Statement dated June 30, 1922. The unexpected result, namely, efficiency in amplification, to be attained from using tubes arranged as specified in this claim and relied on to establish patentability is based, as it appears from the affidavit filed, on using tubes primarily as amplifiers, and this efficiency in amplification is not necessarily inherent in a power limiting device as disclosed by applicant where the amplification is largely reduced by the inclusion of choke coil and high resistance and where, as a matter of fact, no amplification at all in the power limiting device is essential to the operation of the system as disclosed by applicant in the application originally filed.

The subject matter of claim 34 is not disclosed in the application as originally filed, there being no disclosure of the features specified in lines 9 and 10, "up to a much larger current amplitude"; as pointed out above, it was unnecessary for applicant's objects as stated in the original specification to have any amplification in the power limiting device, and if there should be any amplification, the original specification is silent as to whether the current amplitude is a little larger or much larger as now claimed.

Claim 35 is drawn to subject matter not disclosed in the application as originally filed, there being no mention in the original specification of the features specified in lines 8 and 9 of the claim, nor of the features specified in lines 14 to 15.

Applicant has no right to make proposed claim 38 with the meaning it has in the patent to LATOUR, 1,405,523, from which it was copied. The connection specified in the last three lines of the claim has a definite function in Latour's device, while in applicant's device, there is only incidently a connection because the cathode is grounded and the antenna also grounded. The incidental connection appears to have no function in applicant's device. Applicant's invention, as stated in his objects, would be the same if an ungrounded loop antenna were used, but obviously, the claim would not then read on such a construction. Furthermore, the definite function which the connection of Latour has is specified in Latour's claim, namely, for connection to a source of potential. The earth could not be considered a source of potential.

Claim 40 covers an old combination as shown by either CABOT, 916,840, March 30, 1909, 250-20x; or SCHLOMILCH ET AL, 1,165,180, Dec. 7, 1915, 250-20.

Ser. #48,873 - 3.

If the plural-stage repeater is believed to be novel, it should be claimed by itself. However, it is believed no invention is required to substitute for any of the stages as shown in the references other stages of well known form, as a vacuum tube or a push-pull vacuum tube repeater.

For these reasons, the examiner's recommendation is adverse.

Claims 31, 32, 36, 37 and 39 appear to be allowable.

H.S.M.

C. D. Bairnes

Exr., Div. 16.

APPROVED

AUG 1922

Earl Thurston

ASST. COMMISSIONER OF PATENTS

Case 16 24 1071

RECD SEP 14 1922 U.S. PAT. OFFICE

UNITED STATES PATENT OFFICE
16 Room 112

In re application of

HAROLD D. ARNOLD

Serial No. 48,873

Filed September 8, 1915
Allowed February 9, 1922

Subject:

Power Limiting Amplifying Devices.

PATENT OFFICE
SEP 18 1922

PETITION

TO THE COMMISSIONER OF PATENTS:

Your petitioner, HAROLD D. ARNOLD, a citizen of the United States and a resident of Maplewood, in the County of Essex and State of New Jersey, whose post-office address is 40 Ridgewood Terrace, Maplewood, New Jersey, represents that on September 8, 1915, he filed an application for letters patent for an improvement in POWER LIMITING AMPLIFYING DEVICES, serial number 48,873, which application was allowed February 9, 1922, but that he failed to make payment of the final fee within the time allowed by law. He now makes renewed application for letters patent for said invention, and prays that the original specification, oath and drawings may be used as a part of this application.

HAROLD D. ARNOLD

By H. D. Arnold

465 West Street,
New York, Sept 13 ; 1922.

04/80

HAB:FP

1072

Case 16

PAPER NO. 25
AMENDMENT.

UNITED STATES PATENT OFFICE

Division 16 Room 112

In re application of
HAROLD D. ARNOLD

Serial No. 48,873
Filed September 5, 1915
Allowed February 9, 1922

A 281

Subject:
Power Limiting Amplifying Devices.

MAIL ROOM SEP 18 1922

PATENT OFFICE SEP 18 1922

THE COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

Please amend the above identified application as follows:

Page 2, line 6, change "Its" to --An--.

Page 3, lines 5 to 7, cancel "being essential to the operation of the device for the purpose specified by preventing unbalanced currents in the two halves of the device" and substitute therefor --performing an important function in connection with the power or current limiting action of the device as hereinafter described--.

Page 4, line 28, after "leak" insert --which is--; line 29, cancel "rectifier" and substitute --detector--.

Please add the following claims:

--31. The method of reducing detrimental effects of disturbing waves superimposed on waves to be received at a receiving station which comprises utilizing the energy of the received waves to produce a current which varies in amplitude at a frequency widely different from that of the received waves, and passing this current through a circuit containing a device for limiting the energy

passing therethrough to a predetermined value,

32. A system for reducing the detrimental effects of disturbing waves superimposed on waves to be received which comprises devices for producing at a receiving station by means of the received waves an alternating current of a widely different frequency from that of the received waves, a circuit through which the alternating current is to be passed, and means for limiting to a predetermined value the energy passing through said circuit.

33 In an electric system, an incoming circuit and a plural stage amplifier for amplifying signals from said circuit comprising in one stage of said amplifier two vacuum tube repeaters connected in push-pull relation, and at least one stage consisting of a single vacuum tube amplifier feeding into said push-pull stage.

34. In an amplifying system in which the amplitude of the current increases in succeeding stages, a current responsive device actuated by the energy from said system, at least one preliminary amplifying stage consisting of a single vacuum tube amplifier circuit, and a succeeding stage for delivering the amplified current to said responsive device, said last mentioned stage comprising a pair of vacuum tube amplifiers connected in push-pull relation.

35. In a plural stage amplifier circuit for amplifying signal currents, employing vacuum tube amplifiers in which, for relatively strong output currents at least, as the amplitude of the repeated wave becomes larger the distortion of the wave increases, said amplifier circuit comprising at least one stage consisting of a single vacuum tube repeater operating over a relatively small current amplitude range and giving amplification with the required degree of faithfulness of repetition of the signal and a stage into which said single tube stage feeds, for amplifying the repeated wave up to a current amplitude at which undesired distortion would take place in a single one of said tubes used alone, said later stage comprising a pair of vacuum tube repeaters connected in push-pull relation, whereby at said large current amplitude a faithfulness of repetition is obtained consistent with that of the preceding stage.

36. In combination, three electron discharge tubes, means for supplying discharge current to said tubes, two of said tubes being connected in push-pull relation, the other one of said tubes being arranged to impress amplified signal waves on said push-pull connected tubes of such amplitude that at the peak amplitude of said waves, for a given half-cycle the resultant momentary decrease in the normal discharge current through one of said push-pull connected tubes reduces the discharge current through said tube near to zero.

37. In combination a pair of space discharge devices, each of said devices having a cathode, an anode and a grid or control element, anode circuits and grid circuits for said devices, a common source of discharge current connected to said anodes, a common source of alternating current potential connected to said grids, said devices being connected to operate in push-pull relation, the normal discharge current through said tubes being so related to the amplitude of the alternating potential impressed on said grids that at the peak amplitude of said alternating potential the space current through one and the other of said devices alternately is reduced substantially to zero.

38. In an amplifying apparatus for wireless signals and the like, a plurality of thermionic relays comprising each an evacuated bulb, a plate, a filament and a grid in said bulb, transformers having one of their windings in circuit with the filament and grid of each of said lamps respectively, the other winding of one of said transformers being adapted to be connected to a source of potential, a common source of current in circuit with the plate and filament of each of said relays, and a connection between said source of current and the transformer winding adapted to be connected to a source of potential.

38 39. In an electric system, an incoming circuit and a plural stage amplifier for amplifying signals from said circuit, said amplifier comprising

at least one stage consisting of a single electron discharge tube and a stage consisting of a pair of electron discharge tubes connected in push-pull relation, having their input sides connected to the output side of said first mentioned stage, means for supplying discharge current to said tubes, the amplitude of the signal variations in the discharge current of said push-pull tubes being of the order of magnitude of the normal discharge current through said tubes.

R E M A R K S

Claims 31, 32, 36, 37 and 39 of this amendment are the same as the correspondingly numbered claims presented in the amendment filed August 2, 1922 for entry under Rule 78. These claims were indicated as allowable in the Office letter of August 7, 1922.

Claims 33 and 35 are likewise claims 33 and 35 of said amendment and are presented for reconsideration for reasons indicated below.

Claim 34 is modeled after claim 34 of said amendment and reconsideration of this claim in its present form is requested for reasons indicated below.

Claim 38 is the same as the claim which was presented for entry under Rule 78 in an amendment filed July 29, 1922, this claim being copied from the Latour patent 1,405,523 (claim 11).

In applicant's original specification at page 2, lines 27 to 29, the power-limiting device is described as

particularly applicable in radio communication.

At various places in the specification, such as at page 4, lines 25, 31, 32, etc. the vacuum tubes 31 and 38 are identified as amplifiers. This circuit has altogether four stages of amplification, not counting the detector as contributing any amplification; that is, one stage of high-frequency amplification, the two stages of audio-frequency amplification represented by the tubes 31 and 38, and the final stage comprising the power limiter. In the final stage the signaling currents have an amplitude just short of the normal space current through the tubes (page 6, lines 15 and 16).

In the operation of the push-pull stage as an amplifier for the normal signaling currents, the resistance 58 and choke coil 57 do not come into play to cut down the transmitted oscillations since the path taken by these oscillations does not include the elements 57 and 58. That is, the current through 57 and 58 remains a constant until the space current in one of the two tubes has reached zero or substantially zero. So long as the current variations in one tube just balance those in the other, the elements 57 and 58 are not called upon to transmit any more current regardless of the amplitude of the signals. These elements help to determine a certain normal space current, but they in no way impede the production of complemental current variations in the two tubes up to an extreme amplitude of the order of magnitude of this normal space current. (See pages 5 and 6 of the specification).

All of the above is but a restatement of what is clearly explained in the original specification.

The Examiner's grounds for not admitting claim 38 are two:- namely, the ground given in the Office letter of June 30, 1922, and the new and additional grounds stated in the Office letter of August 7, 1922. The latter will be taken up first.

These latter grounds are understood to be that the tubes called for in the claim and as disclosed in the specification are not "primarily" amplifiers, whereas the new result which applicant has established is not inherent in a device such as is described where the device is merely a power-limiter, and (impliedly) not an amplifier. The obvious and sufficient answer to this is the claim itself and the specification. The Examiner's attention is called to the fact that the affidavit and the arguments and amendments which have been presented are not relied on for showing that these tubes called for in the claim are amplifiers. The references made at the beginning of these remarks to portions of the specification point out that the original disclosure affords ample basis for this claim. The language of the claim is unmistakably clear in calling for amplifiers and not merely "tubes". It has further been pointed out above that the amplifying and power-limiting functions of the push-pull stage are to an extent independent in that the power-limiting action takes place only after the maximum signaling amplitude has been reached. Up to that point amplification takes place. Whether or not this push-pull stage is primarily an amplifier or is primarily something else, is entirely beside the question. It is an amplifier and is claimed as such. The affidavit was submitted merely to show that the sub-combination being claimed is accompanied by new and unexpected results, in the high efficiency obtained with it.

It is also beside the question whether or not amplification is inherent in a power-limiting device. It is conceivable that in power limiters in general, of the type shown, there might or might not be amplification depending on the circuit structure. But there is no necessity for conjectures on this point. The specification is in no way inconsistent or obscure in this, for it clearly says that the power-limiter amplifies and is not seen to contain anything to lead anyone to conclude or assume that it might not amplify.

There is therefore a sufficient basis in the original specification for this claim, and unless the obvious meanings of the words used in the claim are to be ignored altogether, there can be no question that what the claim calls for is an amplifying stage in push-pull and a single tube amplifier feeding into the push-pull stage; and not merely a combination of vacuum tubes in which no amplification may be present.

The other ground for not admitting this claim, as stated in the Office letter of June 30, is in effect that no invention would be required to build up the combination claimed, its elements being old. It was pointed out in the remarks accompanying the proposed amendment filed August 2, 1922 that the combination claimed is specific to the push-pull stage following the single stage, and that not only would it be unexpected that one should, in the light of the prior art, combine a push-pull circuit with a single tube amplifier at all, but that there would be no known reason for adopting the specific combination claimed until applicant discovered that the push-pull circuit could be loaded for signal amplification to the point where the space current is reduced near to zero by the signals. With this came the idea of using a

single tube to load the push-pull stage up to this high efficiency point. It is this combination which has proved to have the high efficiency spoken of in the affidavit and due to this specific arrangement three tubes can accomplish in high current amplification what heretofore required a larger number.

But even though the Examiner's holding that no invention would be required to combine amplifiers in this way were a correct holding, which applicant respectfully maintains is not the case, this ground is not sufficient where a new result is obtained with the new combination.

In ex parte McCollum, (C.D. of 1914, page 70) a claim was held to be patentable where it specified structure that could, impliedly without invention, have been assembled from old structures. But the slide valve from Herrschoff's steam engine if substituted in Turcot's gas engine would in its new relation perform the work which previously required two valves. The accomplishment of this result was taken as evidencing invention and as deserving of patentability since:

> "If the structures of the references may be combined or substituted one for the other and the combined function or result is new, the claim should be allowed." (C.D. of 1914, page 73, lines 9 to 11.)

It is not sufficient therefore, merely to say that structures may be combined without invention and to reject a claim on that ground. The new result must not be ignored. In applicant's case the plural stage amplifier defined in claim 33 will give the same output current at given quality that could be obtained only with several more tubes if some other type of connection were used. This new result has been amply proved, and the claim should, it is respectfully submitted, be allowed.

Claim 34 has been redrawn. It is believed to be clearly supported by the original disclosure in view of the fact that the push-pull stage is disclosed as an amplifier for the signaling currents. All of the remarks in connection with claim 33 are applicable also to this claim and it should be allowed for the same reasons.

Claim 35 is believed clearly readable on the original disclosure. The single tube amplifier of line 8 may be either 31 or 38. The very purpose and object in using three stages of audio-frequency amplification in this circuit is to obtain an increased current output, and if there is any advantage at all in using several stages it must come from the fact that the current increases in succeeding stages. Therefore by necessity the current amplitude range over which either tube 31 or 38 operates must be smaller than that over which the push-pull stage operates. The language of lines 8 and 9 is clearly supported since it defines increasing current in successive stages. Lines 14 and 15 define in different terms the limitation contained in claims 36, 37 and 39, on account of which these claims were apparently allowed. If the amplitude of the plate current variations in a single amplifier tube exceeds the relatively small range throughout which the tube has a substantially straight line characteristic the repeated wave is distorted, and the greater the amplitude beyond this range the greater the distortion. The original description states that the amplitude of the signals in the push-pull stage is nearly equal to the normal space current through the tubes. If the signals through a single tube had this amplitude they would be very badly distorted. Since the push-pull stage amplifies, and since the signal variations are nearly equal in amplitude to the normal space current, it is clear that they have a

greater amplitude than they could have in the case of a single tube without being badly distorted. This language, therefore, merely presents in different terms the idea of the large current variations that can occur in the push-pull stage and on account of which the high efficiency is possible. It should be noted that the amount of distortion is a question of first importance in signal amplifiers. The lack of it is a measure of quality. If amplitude alone were of interest a single tube could be used, since by reducing its space current to zero the same amplitude of variation could be produced, but neither the applicant nor any other person skilled in the signalling art at the time of filing of this application would have attempted to repeat signals such as speech at such a high amplitude through a single tube repeater as to reduce the space current in it near to zero. To do so would distort the signals too badly. Applicant did however, disclose a series amplifying arrangement by which he could increase the current amplitude of the signals in successive stages, and in the last stage of which, due to the push-pull connection, the signals could be nearly equal to the space current in amplitude. As defined in this claim, the current operating range in one of the single tubes is small relatively to that of the push-pull tubes, which are operated at an amplitude so great that undesired distortion would be produced in a single tube with the same amplitude of signal. This claim is, therefore, believed to be amply supported by the original disclosure and to be allowable for the same reasons as are given above in connection with claims 33 and 34.

It is not seen that claim 38 copied from the Latour patent has any different meaning in Latour from what it has in the present application. The Examiner has not indicated any particular meaning or force which the claim has in Latour except as regards the connection to the transformer winding.

By referring to page 4 of Latour's specification line 118 to the end of the specification, it is seen that the object of the connection from the battery P (Fig. 3) to the masses M_1, M_2 and M_3 as well as to the primary of T_1 is to define the potential of these portions of the circuit. By connecting these points all together static charges are prevented from building up between parts of the circuit where they might conceivably cause singing. The claim does not include the cores of the transformers nor bring in any function or result for the potential-defining connection. It appears therefore, that this claim attempts to cover broadly a connection from the primary of one of the transformers to the plate-filament circuit of the tubes to prevent the effect of electrostatic potentials between this primary and the plate-filament circuit. Such an a.c. static potential is undesirable as not only causing howling, but as also lowering the efficiency of the transformer. The effect of the conductive connection between the winding 2 and the point 60 of applicant's circuit via the earth would be to tend to prevent the primary 2 from assuming a high static potential relative to the plate-filament circuit and so cause electrostatic transfer across between the primary and secondary of the input transformer, thus reducing the efficiency of the transformer. The patentee could have readily limited his claim 11, as by including the transformer cores for example. Since he did not so limit the claim, it appears in effect to cover other specific circuits than the patentee/including disclosed that which applicant has invented and disclosed, and applicant should be allowed to contest this claim.

The claim may be read element for element on applicant's

circuit as follows: The thermionic relays are applicant's tubes 7 and 21, each of which has a filament, a grid and a plate. The two transformers are 3, 5 and 13,14 respectively, each of which has a winding in the grid-filament circuit of one of said tubes. The "other winding" of applicant's transformer 2, 1, namely the winding 2, is connected to the antenna which is certainly as much a source of potential as Latour shows for feeding his transformer T_1. The common plate source is the battery 15 and the connection from this battery to the primary 3 (which as stated above is connected to the source of potential _____ the antenna) is by way of ground.

Applicant cannot agree that any function is stated in Latour's claim for his connection, nor that in reality it has a different function from applicant's connection of several points of his circuit to ground. In both cases the purpose is to maintain the various parts of the circuit so connected at the same potential. If it is "incidental" that applicant shows a grounded antenna it must not be concluded as also incidental that he has grounded the receiving circuit at various other points including the plate battery, the particular point of the circuit specified in Latour's claim. It is further an ancillary object of any invention, though it may not be so specifically stated in the specification, to make the entire circuit or other arrangement of the particular and preferred form that is described, an efficient system for accomplishing the main objects of the invention. This should be self-evident.

All of the Examiner's objections against admitting claim 26 for purposes of interference appear to be without ground, and it is respectfully requested that this claim be

entered and allowed applicant either with or without the formality of an interference.

Reconsideration of all of the above claims, and allowance, are respectfully requested.

Respectfully,

HAROLD D. ARNOLD

By E W Griffin

463 West Street,
New York, April 13., 1922.

HAB:FF

1086

F 23

MAILROOM SEP 17 1922 U.S. PATENT OFFICE

Case 16

A 295

UNITED STATES PATENT OFFICE

Div. 16 Room 112

In re application of HAROLD D. ARNOLD	Subject: Power Limiting Amplifying Devices.
Serial No. 48,873	
Filed September 3, 1915	
Allowed February 9, 1922	

PATENT OFFICE SEP 18 1922

State of New York)
) ss.
County of New York)

SUPPLEMENTAL OATH

HAROLD D. ARNOLD, whose application for letters patent for an improvement in POWER LIMITING AMPLIFYING DEVICES, Serial No. 48,873, was filed in the United States Patent Office on or about the 3rd day of September, 1915, being duly sworn, deposes and says that the subject matter of the foregoing amendment was part of his invention, was invented before he filed his original application, above identified, for such invention, was not known or used before his invention, was not patented or described in a printed publication in any country more than two years before his application, was not patented in a foreign country on an application filed by his legal representatives or assigns more than twelve months before his application, was not in public use or on sale in this country for more than two years before the date of his application, and has not been abandoned.

Harold D Arnold

Subscribed and sworn to before me this 16th day of September, 1922.

Notary Public

FIB:VP

1087

Div. 16 Room 112 — 800 — Paper No. 26

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

All communications respecting this application should give the serial number, date of filing, name of inventor, and name of the applicant.

HSM:LBG

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON July 12, 1923



Mr. John G. Roberts,
463 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

Harold de F. Arnold, Ser. #588,285, filed Sept. 14, 1922.

Power Limiting Amplifying Devices.

Thomas E. Robertson
Commissioner of Patents.

This action is responsive to amendment and renewal filed Sept. 14, 1922.

This application is informal in this, towit: The residence in the renewal petition differs from that in the preamble. The residence should be uniform.

Claim 38 is rejected for the reasons set forth in lines 15 to 29, page 2, of Office letter of Aug. 7, 1922. The connection specified in line 10 of the claim is in the device of Latour. an actual, physical element of combination inserted for a definite purpose to give a definite apparatus as made clear in Latour's specification. It does not appear from applicant's specification that he had in mind the definite purpose or the definite apparatus which Latour had in mind and defined in this claim. Applicant's grounding of the cathode, a feature quite common in the prior art, may incidently produce an electrical connection to some other element, but such incidental grounding cannot be taken as being the equivalent of providing an actual, tangible connection, as is done by Latour and called for by the claim, as the earth is no part of applicant's invention and should not be considered

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1087

as such. The claim calls for a connection between said source of current and the transformer winding; the only connection applicant has provided is connection from the source to the ground and not to the transformer winding. There is no electrical path from the source of current to the transformer without including, in addition, to the connection which applicant has provided, a portion of the earth and elements 3 and 4. The path including all these elements cannot be termed a connection, as has been decided in the application of Kendall, Serial No. 149,782, now patent No. 1,453,982, by the Examiners-in-Chief at page 7, lines 1 to 8, of their decision. The incidental path between the transformer winding and the source of current shown by applicant does not function as does Latour's connection and does not serve to keep these elements at the same potential as would a connection, as specified by the claim, because, in applicant's device, there is a potential drop across the elements 3 and 4 and also across the two ground connections which, even when well made, have considerable resistance. In the language of the Examiners-in-Chief, page 7, in the decision cited above, "in other words, there is nothing in the specification, as originally filed, to either suggest the features characterizing the" rejected "claims or that" applicant "then contemplated any such features or the advantages accruing therefrom".

Claims 1 to 37 and 39 are considered allowable.

As claim 38 has been twice considered by the examiner, and a clear issue has been reached, this action is made final. In accordance with the practice outlined in Ex parte Heiser and Woolford, 864 OG 863, a time limit for appeal to the Examiners-in-Chief of thirty days from the date hereof is hereby set.

R.S.M.

O. O. Ramey
Exr. Div. 18

1089

Case

PAPER NO 27 X
AMENDMENT

UNITED STATES PATENT OFFICE. & affdt

Division 16 Room 112 not entered)

APPLICATION DEPT. AUG 13 1923 PATENT OFFICE

In re application of

HAROLD D. ARNOLD

Serial No. 588,285

Filed September 14, 1922

Subject

POWER LIMITING AMPLIFYING DEVICE

THE COMMISSIONER OF PATENTS,
Washington, D. C.

AUG 14 1923

Sir:

Responsive to the Office action of July 12, 1923, please amend this application as follows:

Page 1, line 8, cancel "East Orange" and substitute --Maplewood--.

R E M A R K S

The change directed above cures this case from the objection of being informal.

Applicant is very reluctant to ask any further consideration of this case by the Examiner, and would not do so except for two things; first, that he feels that the Examiner has based his holding in part upon a slight misconception of the actual facts of the situation, and that a brief explanation of these facts at this point in the proceedings would be helpful: and secondly, that the Examiner in his second action raised points which had not previously been mentioned, and that applicant should be given an opportunity of replying to the Examiner on these particular points rather than having to discuss them, in the first instance, before an appeal tribunal.

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Accordingly the Examiner is respectfully asked to reconsider claim 38 and the question of applicant's right to make it, in view of the following.

The Examiner in the action of July 12, 1923, has based his adverse holding on four grounds. These are:

1. That whereas the patentee Latour shows a connection as a physical element of combination with a definite purpose to give a definite apparatus, applicant's grounding is not equivalent to an actual, tangible connection.

2. That the "path" which applicant shows includes a portion of earth and the elements 3 and 4. Examiner cites a decision by the Board of Examiners-in-Chief to support the holding that because of the ground and elements 3 and 4 included in this path, the path cannot be termed a connection.

3. That applicant's path does not function as does the patentee's connection.

4. The language of the decision referred to is adopted, stating that there is not in the original disclosure, any suggestion of the features claimed or that applicant then contemplated any such features or the advantages accruing therefrom.

It is particularly with regard to the first point, that applicant feels that the Examiner has gone rather far afield of the actual situation and of practical considerations. It is true that Arnold shows six different ground connections in his drawing, but it is unreasonable to suppose that any person who set out to build the apparatus according to Arnold's specification would actually provide six different binding-posts each marked "ground" and instruct users to make six separate connections to earth. The Examiner has taken too academic a view of a mere convention in the drawing. Any workman of even

ordinary skill would drive a single rod into the ground and connect all of the points shown grounded in the drawing to this single rod. This being so, even though applicant carried his appeal to the highest court and obtained an adjudication on the grounds urged by the Examiner to the effect that Latour's claim does not read on applicant's drawing, such a final decision could not be invoked in support of a non-infringement in the case of an actual embodiment of the system which Arnold shows, in an apparatus constructed as anyone in the trade would construct and use it. Hence a decision of this nature would be of no value whatever in practice.

The Examiner is asked to withdraw his holding of absence of physical connection in Arnold's showing, since the convention employed would at the time of filing the application mean to any workman of ordinary skill, that these grounded points are in an actual apparatus all to be connected together and to ground. The Examiner is also referred to the accompanying affidavit of Heising for the opinion of an expert in the art to which this application pertains.

As to the second point upon which the Examiner bases his holding, it is to be noted that the present case is quite different from that presented to the Board of Examiners-in-Chief in Kendall's appeal in Serial No. 149,782. There the applicant showed a path containing a battery and was attempting to claim a path of low impedance, the specification being silent on the impedance of the path. Here the question is whether or not a connection exists between two points in a circuit in such a sense as is within the fair meaning of a claim originating in another patent application and copied for purposes of interference. It is well settled that under

such circumstances the claim is to be given the broadest interpretation which it will bear in view of the prior art. In all such cases it is borne in mind that no two applicants will show identical embodiments and that a claim must always be construed with regard to equivalents. We have here the question of how broadly a claim may be interpreted to read on a different physical structure, whereas the Board, in Kendall's appeal, had to consider whether a limitation to specific properties of a path were warranted where the disclosure was in broad terms. Furthermore, there was no question of interference to influence the decision of the Examiners-in-Chief. Applicant contends that the proper guide for construing this claim is to be sought in Latour's disclosure, taken in the light of the prior art, and that only such limitations should be placed upon the claim as the patentee included or as the prior art requires.

It is found upon referring to the patentee's specification that he was perfectly general both in the description and claim. Nothing is found as to the impedance of his connection, the only emphasis being upon the points between which the connection is made, and as to this there is some latitude, for the connection may be made "to any point of the battery P, either to the positive pole or to the negative pole or to an intermediate cell as shown in dot and dash lines in Fig. 3" (page 4 of patent, lines 127-129). All that the claim specifies is "a connection" and this can only be taken to mean a physical connection of some kind.

This brings us to point 3 and to the question of whether the connection which Arnold shows is capable of functioning in the manner that Latour's connection is intended to function, that is, reduction of the singing tendency.

The accompanying affidavit of Heising is respectfully referred to as substantiating applicant's contention that under certain operating conditions, as explained in the affidavit, applicant's connection would secure the advantages pointed out by the patentee, and this is all that can be affirmed of Latour's circuit. It is thought that the affidavit will speak sufficiently clearly on this question, and without further comment we may pass to point 4 of the Examiner's holding.

This point is really related to point 2 and involves the question of whether applicant had any such purpose in mind, such as preventing singing, by his particular mode of connection or whether he contemplated the advantages of his connection. As a general proposition of patent law the theory that an applicant must realize and have in contemplation the advantages inhering in his invention in order to lay claim to them cannot stand in view of such decisions as Briggs and Jacobi v. Kaisling. (Court of Appeals D.C.) 311 O.G. 5 (June 5, 1923) and Morgan Engineering Co. v. Alliance Machine Co. 176 F.R. 107. Both of these decisions are regarded as closely in point in the present case. They both, moreover, hold very clearly that contemplation of all of the advantages flowing from applicant's structure is no criterion of whether he invented the structure. In the light of these and other equally authoritative decisions, the fourth point mentioned above is clearly unsound in its application to the facts of this case.

Quoting from Briggs et al v. Kaisling:

> "Even though the particular advantage had not been appreciated at the time, nevertheless, had it been an inherent function of the device as designed and constructed, the inventor could not have been deprived of it." (Page 4, lines 6 - 10).

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Serial No. 568,285 --6.

Quoting from Morgan Engineering Co. v. Alliance Machine Co.:

"Moreover, as appears in the statement, it is expressly stated in claims 3, 4 and 5 of the letters patent that the hoisting-chains depend between the main and supplementary girders, and this fact is also displayed in Fig. 2 of the drawings. Even if the patentee at the time of making his application did not know of this advantage, or knowing failed distinctly to express it, he, in view of what he did state and show, is entitled to have his invention considered with reference to it. Indeed, the crane cannot be constructed and operated in accordance with the plain terms of his description without observing and securing this advantage." (Page 107, lines 11 - 20).

Applicant has established (1) that he has disclosed an actual physical connection between the points specified in the claim; (2) that this is a connection within the ordinary sense of the term as used in the claim; (3) that applicant's connection functions in a similar manner to the patentee's; and (4) that the practice as laid down by leading cases would amply warrant the allowance of this claim to applicant.

Reconsideration with allowance is requested.

Respectfully,

HAROLD D. ARNOLD,

By W. G. Gregg,
Attorney.

463 West Street,
New York, N.Y.,
Aug 9, 1923

H.D.A:B

1095

#27

U N I T E D S T A T E S P A T E N T O F F I C E

Division 16 Room 802

AUG 14 1923

In re application of
HAROLD D. ARNOLD
Serial No. 586,285
Filed September 14, 1922

Subject:
POWER LIMITING AMPLIFYING DEVICE.

AFFIDAVIT OF HEISING

RAYMOND A. HEISING, being duly sworn, deposes and says as follows:

I have been continuously in the employ of the Western Electric Company, Incorporated, serving in the capacity of Radio Engineer, since July, 1914, and during the entire period of my employment, down to and including the present, I have been engaged on problems involving high frequency generation, transmission, reception and the like.

I have considered the circuit shown in Fig. 3 of U. S. patent No. 1,405,523 to Latour dated February 7, 1922, and I have read his description of it. From my experience in the experimental and practical high frequency field, I am able to state that the connection shown in broken lines from the battery P to the primary winding of the transformer T_1 would not under all conditions of operation aid in reducing the singing tendency. Under some conditions, this connection would aid materially in reducing singing. The problem of eliminating singing or free oscillations in a complex circuit is not one which can be solved in a perfectly definite and straightforward manner by a method of precomputation on account of the large number of factors that can influence the development of such oscillations and the impossibility of predicting which influence will be of consequence. Given a drawing of a circuit such as the

patentee shows, it would be impossible for an expert to say a priori with assurance whether the circuit would sing or not. It is quite the general practice in setting up a new type of circuit to try different known expedients in order to determine experimentally which is the most effective means in the particular case. I am of the opinion that in some instances, the patentee would obtain different degrees of singing tendency dependent upon whether the connection from the battery P is made to the upper or to the lower terminal of the coil T_1. It is possible that in some conditions of operation, this connection might actually increase the singing tendency, but I am of the opinion that in the great majority of cases, such a connection would be advantageous in stabilizing the circuit against singing.

I have also inspected the drawing in application Serial No. 588,288 of Harold D. Arnold, originally filed September 3, 1915, renewed September 14, 1922, and am of the opinion that under many of the operating conditions in which Latour's connection would result in reducing the tendency to sing, it would be an inherent property of Arnold's circuit by virtue of the connection from the coil 2 to the antenna ground and thence to the grounds 60 and 61 to operate in the same manner to reduce singing.

It is a common tendency for amplifier circuits to sing at a frequency much higher than the frequency at which they are being operated. This tendency would no doubt be present in Latour's circuit. For frequencies high compared with the operating frequency Arnold's tuning condenser 3 would be practically impedanceless so that at the singing frequencies the potential across the condenser would in many practical cases have negligible effect on the singing tendency and would not prevent the stabilizing action of the connection

to coil 2 from taking place.

I am of the opinion that the separate ground connections shown in Arnold's drawing, would, without the least question, be taken by a mechanic of ordinary skill in constructing circuits of this character to indicate that in practical apparatus only a single connection is actually to be made to earth and that the points shown as grounded are first to be connected together and then to ground.

Raymond A. Heising

Sworn to and subscribed before me
this 9th day of August, 1923.

Notary Public

NOTARY PUBLIC, Queens County
Queens County Clerk's No. 1174
Certificate filed in New York County
Clerk's No. 186; Register's No. 42[illegible]
Commission Expires March 30th, 1924

H.B:BF

1098

2—079

INTERFERENCE.

Interference No. 49954 *Paper No.* 28

Name, Harold de Forest Arnold.

Serial No. 588,285; renewal of #46873; filed Sept. 3, 1915.

Title, Power Limiting Amplifying Devices.

Filed, Sept. 14. 1922.

Interference with H. C A. Latour.

DECISIONS OF

Primary Examiner, ... *Dated,* .....

Ex'r of Interferences, Judg Dissolved *Dated,* Dec. 24, 1923

Board, ... *Dated,* .....

Commissioner, ... *Dated,* .....

REMARKS:

This should be placed in each application or patent involved in interference in addition to the interference letters by Primary Examiner.

1099

Examiner of Interferences. Paper No. 29

[INTERFERENCE.]

Aug. 21, 1923.

DEPARTMENT OF THE INTERIOR,

HSM:LBG

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C.

U. S. PATENT OFFICE
OCT -5 1923
MAILED

Mr. John G. Roberts,
463 West St.,
New York, N. Y.

Please find below a copy of a communication from the Examiner concerning the

Appli. of Harold de Forest Arnold, Ser. #588,285, filed Sept. 14, 1922
Renewal of Ser. #48,873, filed Sept. 3, 1915.
Power Limiting Amplifying Devices.

Very respectfully,

Room No. 112

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

THOS. E. ROBERTSON
Commissioner of Patents.

49454

The case, above referred to, is adjudged to interfere with others, hereafter specified, and the question of priority will be determined in conformity with the Rules.

The statement demanded by Rule 110 must be sealed up and filed on or before NOV 26 1923, *with the subject of the invention, and name of party filing it, indorsed on the envelope. The subject-matter involved in the interference is*

1. In an amplifying apparatus for wireless signals and the like, a plurality of thermionic relays comprising each an evacuated bulb, a plate, a filament and a grid in said bulb, transformers having one of their windings in circuit with the filament and grid of each of said lamps respectively, the other winding of one of said transformers being adapted to be connected to a source of potential, a common source of current in circuit with the plate and filament of each of said relays, and a connection between said source of current and the transformer winding adapted to be connected to a source of potential.

The interference involves your application above identified; and

A patent, No. 1,405,523, granted Feb. 7, 1922, on application for Audion or Lamp Relay or Amplifying Apparatus, Serial No. 209,269, filed Dec. 28, 1917, by Marius C. A. Latour, whose postoffice address is 10 rue Auber, Paris, France, whose attorneys are Haseltine, Lake & Co., 11 Park Row, New York, N. Y., and whose associate attorney is H. W. Plucker, c/o Haseltine, Lake &

1100

Ser. #588,285 - 2.

Co., 15, Park Row (Suite 1632-1639), New York, N. Y.

The count of the interference is claim 38 of ARNOLD and claim 11 of LATOUR.

HSM

Exr., Div. 16.

1101

Div. 16 Room 112 Paper No. 28 30

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

HSM:LBG

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON January 7, 1924

Mr. John G. Roberts,
463 West St.,
New York, N. Y.

PATENT OFFICE JAN 7 1924 MAILED

Please find below a communication from the EXAMINER in charge of the application of

Harold de F. Arnold, Ser. #588,285, filed Sept. 14, 1922

Power Limiting Amplifying Devices.

Thomas E. Robertson
Commissioner of Patents.

This application comes before the examiner on the dissolution of the interference in which it was involved.

In view of applicant's admission and the decision in the interference, claim 38 stands finally rejected. Since, at the declaration of the interference, the prosecution of this case before the examiner was closed except as to matters arising out of the interference, this action is made final.

HSM.

Exr., Div. 16.

MAIL ROOM JAN 19 1924 PATENT OFFICE

PAPER NO. 31
AMENDMENT

UNITED STATES PATENT OFFICE.

Division 16 Room 112

In re application of HAROLD deF. ARNOLD	*Subject.*
Serial No. 588,285	Power Limiting Amplifying Devices
Filed September 14, 1922	

THE COMMISSIONER OF PATENTS,
Washington, D.C.

PATENT OFFICE JAN 21 1924

Sir:

In response to the Office action of January 7, 1924, please amend this application as follows:

Claim 34, line 5, change "simple" to --single--.

Cancel claim 38, and renumber claim 39 as 38.

R E M A R K S

This amendment cancels the claim finally rejected and corrects a typographical error in claim 34. The limitation in this claim was intended to be similar to that in claim 38, to a stage employing a single vacuum tube feeding into the push-pull stage.

An allowance is requested.

Respectfully,

HAROLD deF. ARNOLD

By _____
Attorney

463 West Street,

New York, JAN 18 1924

HAD:SI

PLAINTIFF S' EXHIBIT No. 65

1103

DIV. 16 — 1914 — (EX'R'S BOOK) 214-3

NUMBER (Series of 1900).

841568 — PATENT No. 1129942

Name Harold De Forest Arnold
Assn to Western Electric Company,
New York, N.Y., a corp of N.Y.

of East Orange

County of

State of New Jersey

Inception Gaseous Repeaters in Circuits of Low Impedance.

Division of Appn. No. — Filed — 191

PARTS OF APPLICATION FILED	ORIGINAL	RENEWED
Petition	May 28, 1914	, 191
Affidavit	" " , 1914	, 191
Specification	" " , 1914	, 191
Drawing 2 Sheets	" " , 1914	, 191
Photo Copy	June 4 , 1914	, 191
First Fee Cash	16 May 28, 1914	, 191
" " Cert	, 191	, 191
Appl. filed complete	May 28 1914	, 191
Examined and Passed for Issue	Oct 8, 1914	, 191
W. Atkinson	Exr. Div. 16	Exr. Div.
Notice of Allowance	Oct. 13, 1914	, 191
Final Fee Cash	30 Oct 14 1915	, 191
" " Cert	191	, 191
Patented	March 2	, 191 5

By Commissioner.

Attorney De Witt C. Tamer & Stanley Roberts
1463 Broadway New York, N.Y.

Associate Attorney

(No. of Claims Allowed 7) Title as Allowed Gaseous Repeaters in Circuits of Low Impedance

179-171

TO ALL WHOM IT MAY CONCERN:

Be it known, that I, HAROLD D. FORREST ARNOLD, a citizen of the United States, residing at East Orange, in the County of Essex and State of New Jersey, have invented certain new and useful improvements in Gaseous Repeaters in Circuits of Low Impedance, of which the following is a full, clear, concise, and exact description.

This invention relates to the use of repeaters generally,

65/2

and of vacuum discharge repeaters more particularly, as amplifiers without transformers. Still more particularly, it relates to the use of thermionic repeaters for securing amplification of current in circuits of low impedance. By a thermionic current is meant current discharge from a hot cathode. Examples of thermionic repeaters are the DeForest audion disclosed in patent No. 879,532, dated February 18, 1914, and others, the Von Leiben & Riess repeater disclosed in patent No. 1,038,910, dated September 17, 1912, etc. By vacuum discharge is meant current discharge between electrodes in space from which nearly all atmosphere is exhausted. The expression vacuum discharge repeaters is intended to include repeaters of the thermionic types and also those in which current flows between electrodes in space maintained in a conductive state by the arc or otherwise. The mercury arc repeater of an earlier application of this applicant, Serial No. 709,445, filed July 15, 1912, is an example of the class of vacuum discharge repeaters but it is not of the thermionic type.

In many instances it is necessary or desirable, for securing the best results, to exclude transformers from the circuit. Such is the case, for example, in those circuits in which the frequency is so low that efficient transformers are costly and difficult to design, as is the case in telegraph circuits in general and especially in submarine and wireless telegraph circuits. It is particularly desirable to exclude transformers from circuits in which an exact reproduction of wave form is necessary for legibility, as, for example, in submarine cable circuits. It is also desirable to exclude transformers from circuits in which undistorted amplification must be secured over a wide range of frequencies, as, for example, in the reproduction of speech.

and music.

Heretofore it has been necessary to employ transformers in circuit with the audion in order to secure sufficient amplification of current by the audion, and this is especially true where the amplification is desired in circuits of low impedance. This is due to the fact that the impedance of the input circuit of an efficiently operating audion is very high, at least 100,000 ohms and in general as high as 10 megohms. Hence, in a circuit of low impedance, if no transformer is used, the larger part of the possible current amplification by the audion is lost. For example, if the impedance of the input circuit of the audion is only 100,000 ohms and the input circuit of the audion be connected, without the use of transformers, in a line of 1000 ohms impedance, at least 90% of the possible current amplification is lost.

Moreover, in the case of audions of the prior art, the impedance in the output circuit of the audion is always so great that a considerable additional loss of possible amplification must occur if the output circuit of the audion is directly connected to a circuit of low impedance.

It has been discovered that audions of the usual type may be so constructed that, without the use of transformers, they will step up the input voltage of either direct current or alternating current of any frequency in one step to as much as 30 times its original value, or in two successive steps to as much as 500 times its original value. The voltage amplification thus secured is entirely free from wave distortion whatever may be the initial frequency and wave form. This type of audion will, for convenience, be hereinafter referred to as the high-voltage output audion.

It has furthermore been discovered that audions may be constructed which will step down the input voltage, for

example, to one-third of its original value. This last mentioned type of audion has a high current and a low voltage output. Because of its low output impedance, such type of audion can be worked efficiently into a line of like impedance. This new type of audion will, for convenience, hereinafter be referred to as the high-current output audion.

The structures which will provide the greatest degree of efficiency in the above mentioned different types of audions form the subject-matter of a copending application of even date herewith.

It has been discovered that a combination of one or more of the aforementioned high-voltage output type of audions working into one of the high-current output type, will operate, without transformers, from a line of low impedance, for example 250 ohms, into a like line with a resultant current much greater, fifty or more times greater, than would flow in the second circuit if it were directly connected to the first circuit. The present invention is directed to such combination of two different types of repeaters, preferably audions. A system designed to secure the same result and employing a large number of the high-voltage output type of audions connected in multiple and working into a common output circuit in lieu of a single audion of the high-current output type, forms the subject-matter of still another application for patent of even date herewith.

The present invention may be more readily understood by reference to the accompanying drawings in which—

Fig. 1 is a view in perspective of an audion of the high-voltage type;

Fig. 2 is a similar fragmentary view of an audion of the low-voltage type;

Fig. 3 is a similar fragmentary view of the two

different types of audions embodied in a unitary structure;

Fig. 4 shows a circuit arrangement embodying this invention in which a plurality of audions of the high-voltage type in tandem work into an audion of the low-voltage type;

Fig. 5 shows a simplified circuit arrangement giving the same result as in Fig. 4;

Fig. 6 shows a still further modification more particularly applicable to telephone circuits;

Fig. 7 shows a plurality of audions of the high-voltage type in tandem working into a plurality of audions of the high-current output type, each of the latter feeding into a separate output line; and

Fig. 8 shows a circuit arrangement embodying the invention in which the two different types of audions are combined in one bulb.

Like reference characters refer to like parts throughout the several views.

In the drawings, the audions 1 are of the high-voltage output type and the audions 2 are of the high-current output type. In the former type, the input electrode may be in the form of a grid, preferably made of very fine wire with a fine mesh or the like, and the output anode or plate 4 is placed at a considerable distance from the cathode which is preferably a filament 3, as shown. The filament need not present a large active area. The filament, grid and plate are as usual sealed in an evacuated bulb 5. In order to secure best results in this type of audion, the grid should be near the filament, the plate should be distant from the filament, and the grid should present a finely meshed or discontinuous surface between the filament and the plate.

In the high-current output type of audion, the

input electrode or grid 7 may be at any side of the filament and should have a coarse mesh or preferably consist merely of a short length of wire. The output electrode or plate 8 is placed as near to the filament 9 as is conveniently possible. The filament preferably presents a large, active area. The filament, grid and plate are as usual sealed in an evacuated bulb 10. In order to secure the best results in this type of audion, the grid and plate should both be near the filament, the filament area should be large, and the grid should present the least possible obstruction between the filament and plate.

As hereinbefore stated, the high-voltage output type of audion gives an amplification with low current and high voltage in its output circuit; whereas the high-current output type gives amplification with high current and low voltage, and hence low impedance, in its output circuit.

In Fig. 4, two high-voltage output audions 1, 1 connected in tandem are shown working into a high-current output audion 2. The batteries 11 are preferably of such value as to make each of the grids 3, 3 and 7 normally about five volts negative with respect to its adjacent filament. The several filaments are heated by the respective batteries 12. The output circuit of each audion includes its plate, a high resistance 14, a battery 13 and the filament of the audion. The resistance 14 should be, for example, 100,000 ohms or more. The input circuit of the first audion of the group is directly connected to the input line 15. The input voltage on the grid of the first audion 1 causes an increase in the voltage of the current flowing in the output circuit of said audion, thereby developing a voltage change on the grid of the next audion of the series, and so on. As a result of such construction and arrangement of these audions, the voltage in the input circuit of the second of the two audions in tandem

is much greater than that impressed upon the first, although the current in the interconnecting circuit is small. The audion 2 acts as an amplifier in which the current is increased and the voltage lowered in its output circuit. Because of the fact that the impedance in the output circuit of the audion 2 is lowered, it can be worked efficiently into a line 16 of low impedance. It has been found, for example, that the amplifying means shown in Fig. 4 will work from an incoming line of 250 ohms impedance into an outgoing line of like impedance with a resultant current of more than fifty times that which would flow in the outgoing line if the latter were directly connected to the incoming line.

Fig. 5 shows a simplification of the system illustrated in Fig. 4, in that a common battery 12 furnishes current to all the filaments, said filaments being connected in series with the battery, and a common battery 13 serves for all of the plates.

Fig. 6 shows a further simplification of the system illustrated in Fig. 5. An impedance coil 17 is included in bridge of the output circuit of each audion, and in the output circuit of the two audions 1, 1, condensers 18, 18 are inserted in series with the resistance 14. By such arrangement the several batteries 11 may be largely reduced in voltage. This arrangement is particularly applicable to embodiment in a telephone system.

Fig. 7 shows a plurality of the high-voltage output audions in tandem working into a plurality of the high-current output audions, each of the latter working into its own output circuit 19, 20 or 21. Otherwise, the circuit arrangement is substantially that shown in Fig. 5. The arrangement shown in Fig. 7 is particularly applicable to the operation of several loud-speaking receivers from a common talking circuit.

Fig. 8 shows a structure and circuit arrangement in which an audion of the high-voltage output type works into an audion of the high-current output type, the two audions being contained in a single bulb and operating from a common filament having one branch 5 for the audion 1 and another branch 9 for the audion 2. The input electrode 7 of the audion 2 is shown in the form of a short length of wire. The circuit arrangement is substantially that illustrated in Figs. 4 and 5, and further description thereof is deemed unnecessary. This structure and arrangement have been found to operate successfully, without the interposition of transformers, between lines of the impedance of ordinary telephone lines.

As applied to submarine cable work for amplifying the feeble current at the receiving end the invention is of special importance. The large amplification attained makes it possible to operate over such cables at greatly increased speed. Furthermore, less delicate recording devices will suffice as a substitute for the ordinary siphon recorder. Moreover, the high amplification secured renders possible the direct repetition from one section of a cable to another or from submarine to land telegraph lines. The invention is also particularly adapted for use in circuits where especially pure, loud reproduction of speech or music is desired. In general in the art of submarine, land and wireless telegraphy, the invention is of importance with reference to recording, high-speed working and direct repetition from one type of system to another type of system.

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What is claimed is:

1. The combination with a repeater having a characteristi current and voltage output, of a second repeater into which the first mentioned repeater works, said second repeater having a different current and voltage output.

2. The combination with a repeater having a low-current and high-voltage output, of a second repeater into which said first mentioned repeater works, said second repeater having a high-current and low-voltage output.

per Cl

3. The combination with a vacuum discharge repeater having a low-current and high-voltage output, of a second vacuum discharge repeater into which said firs mentioned repeater works, said second repeater having a high-current and low-voltage output.

4. The combination with a source of feeble electric currents, of a thermionic repeater having an input circuit directly connected to said source of current and an output circuit of high voltage, and a second thermionic repeater having an output circuit of low impedance and having an input circuit directly connected to the output circuit of said first mentioned repeater.

5. The combination with a plurality of repeaters having a low-current and high-voltage output, of a repeater having a high-current and low-voltage output, and a system of circuits connecting said repeaters in tandem.

per Cl

6. The combination with a plurality of repeaters connected in tandem, the first repeater of the series having a high-voltage output and the last repeater of the series having a high-current output.

7. The combination with a plurality of thermionic repeaters connected in tandem, the first repeater of the series having a high-voltage output and the last repeater of

the series having a high-current output.

8. The combination of a plurality of thermionic repeaters connected in tandem, the last repeater of the series having a high-current and low-voltage output.

9. The combination with an incoming and an outgoing line of low impedance, of a plurality of repeaters in tandem, the first of said repeaters having a high-voltage output and the last of said repeaters having a high-current output, and the first of said repeaters having its input circuit directly connected to said incoming line, and the last of said repeaters having its output circuit directly connected to said outgoing line.

10. The combination with an incoming and an outgoing line of low impedance, of a plurality of thermionic repeaters in tandem, the first of said repeaters having a high-voltage output and the last of said repeaters having a high-current output, and the first of said repeaters having its input circuit directly connected to said incoming line, and the last of said repeaters having its output circuit directly connected to said outgoing line.

11. The combination with a line of low impedance, of a current amplifying means directly connected thereto, said amplifying means comprising a plurality of repeaters in tandem, the first of said repeaters having a high-voltage output and the last of said repeaters having a high-current output.

12. The combination with a line of low impedance, of a current amplifying means directly connected therewith, said amplifying means comprising a plurality of thermionic repeaters in tandem, the first of said repeaters having a high-voltage output and the last of said repeaters having a high-current output.

1111

12. The combination with a repeater, of a plurality of vacuum discharge repeaters connected in multiple with the output circuit of said first mentioned repeater, said first mentioned repeater having a high-voltage output and said other repeaters each having a high-current output.

13. The combination with a thermionic repeater, of a plurality of thermionic repeaters connected in multiple into which said first mentioned repeater works, said first mentioned repeater having a high-voltage output and said other repeaters having a high-current output.

14. The combination of two thermionic repeater structures connected in tandem and having a common enclosing bulb, the first of said structures having a high-voltage output and the other a high-current output.

Sigs.

GKF-DG

In Witness Whereof, I hereunto subscribe my name this 25 day of May, A. D., 1914.

Harold DeForest Arnold

Witnesses:

E. Eckler

M. L. Stall

State of NEW YORK }
COUNTY OF NEW YORK } ss.

HAROLD DeFOREST ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of East Orange in the County of Essex and State of New Jersey and that he verily believes himself to be the original, first, and sole inventor of the improvement in Gaseous Repeaters in Circuits of Low Impedance described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in the United States of America or any foreign country before his invention or discovery thereof or more than two years prior to this application; or in public use or on sale in the United States for more than two years prior to this application and that no application for foreign patent has been filed by him or his legal representatives or assigns in any foreign country.

Harold DeForest Arnold

Sworn to and subscribed before me this 25 day of May 1914.

Elie Eckler

Notary Public.

Div. 16 Room 109
Address only
"The Commissioner of Patents
Washington, D. C."
and not any official by name.

1146

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON July 31, 1914.

Mr. John G. Roberts,
463 West Street,
New York, N. Y.

U. S. PATENT OFFICE
JUL 31 1914
MAILED

Please find below a communication from the EXAMINER in charge of your application.

H. DeF. Arnold, S. No. 841,868, filed May 28, 1914.
Gaseous Repeaters in Circuits of Low Impedance.

This application has been examined.

Claims 1, 2, 3, 5, 6, 8, 9 and 11 are rejected on the patent to Warth, 960,458, June 7, 1910, 179 - 170. In this patent two different types of relays or amplifiers are connected in tandem so that the out-put circuit of the first works into the in-put circuit of the second. The two amplifiers have entirely different characteristics. The first amplifier consists of an electromagnet C having control of microphone elements A and a which are of extremely small mass so as to be easily operated by weak currents. The second electromagnet C' is polarized and actuates a granular carbon resistance cup. It is clear that the voltage and current out-put of the first circuit is different from the voltage and current out-put of the second amplifier. It might very well be that the amplifier a would produce a high voltage of current flow while the amplifier C' would produce a low voltage but a high current flow. In this system this would be a mere matter of proportioning the parts. Consequently it is be-

lieved that the claims do not define over this system.

Claim 8 is rejected on the ground that it involves merely connecting a plurality of audions in tandem. This would be suggested by deForest, 995,126, June 13, 1911, 179 - 171. The statement that the last repeater has a high current low voltage out-put does not define over the ordinary audion as what is high and what is low is merely relative, and so far as the claim is concerned it comprises merely a plurality of audions all having the same characteristics and hence does not properly define applicant's invention.

Claims 4, 7, 10 and 12 to 15, inclusive, appear to be allowable as at present advised.

Attention is further called to French patent, 377,413, Sept. 6, 1907, 179 - 171, and Lindridge, 1,047,956, Dec. 24, 1912, 179 - 171.

Examiner, Division XVI.

1118 SEP 11 1914 ✓ PARK & NO 3 AMENDMENT A

UNITED STATES PATENT OFFICE
Division 16 - Room 109

In re application of)
H. DeF. Arnold,) Gaseous Repeaters in
Serial No.841,568,) Circuits of Low Impedance.
Filed May 28,1914.)

PATENT OFFICE SEP. 12. 1914 REC'D & FILED

COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

In response to the Office action of July 31,1914, please amend the above entitled application as follows:

Erase claims 1, 2, 3, 5, 6, 8, 9 and 11, and renumber the remaining claims accordingly.

Claim 1 (original 4), line 2, change "or" to --of--.

REMARKS

It is believed that applicant's invention is amply covered by the claims allowed, and the application has therefore been amended by compliance with the Office rejection of the remaining claims. It is noted that the Warth patent does not disclose a system which is at all adapted for the purposes of applicant's invention. The statement in the Office action, therefore, that in this patent it might be that one amplifier would produce a high voltage, while the other amplifier would produce a low voltage and high current, is objected to. What might have been disclosed in this reference should not be considered as affecting applicant's right to claims on his disclosure.

Respectfully,

H. DeF. ARNOLD,

By F. B. Roberts
Attorney

463 West Street,

New York, September 10, 1914.

PGR-R

DOCKET CLERK
OCT 16 1914
OFFICE

1119
PAPER NO 6
AMENDMENT

UNITED STATES PATENT OFFICE
Division 15, Room 109

In re application of
Harold DeForest Arnold
Serial No. 841,568
Filed May 28, 1914.

Gaseous Repeaters in Circuits of Low Impedance

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Please further amend this case as follows:

Page 4, line 9, after "application" insert --in my name, Ser. No. 841,567 filed--; same page, line 24, after "type" insert a comma; same page, line 25, after "patent" insert --in my name, Ser. No. 841,569 filed--; same page, line 29, after "high-voltage" insert --output--; line 31, change "low-voltage" to --high-current output--.

Page 5, line 12, change "low-voltage" to --high-current output--.

Respectfully,

HAROLD DeFOREST ARNOLD,

By A C Hammond

Attorney

463 West Street,

New York, October 7, 1914.

Approved
OCT 19 1914
R. F. Whitehead

The proposed corrections being merely formal, it is recommended that this amendment be entered under Rule 78, without withdrawing the case from issue. The final fee has not been paid

W A Kinnan
Examiner Div.

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PAGE

PLAINTIFF S' EXHIBIT No. 66

1120

ABANDONED

NUMBER (Series of 1912). 59210 — 1915 — (EXT'S BOOK) ~~43-14~~ 72-18

DIV. H 6 3 1 — PATENT No.

Name. Harold De Forest Arnold, Assignor to ~~Western Electric Company, a New York~~ A.T. & T. Co., a corp. of ~~Illinois~~ New York.

of East Orange

County of

State of New Jersey

Invention Thermionic Devices and Method of Constructing and Operating the Same

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Attorneys De Witt C. Tanner & John G. Roberts, 463 West St., New York, N.Y.

~~Assistant Attorneys~~ Geo. E. Folk, ~~Wash. D.C.~~ New York, N.Y.

~~Witnesses~~ ~~Geo. E. Folk~~

No. of Claims Allowed , Fee $ Allowed

Class Frank H. Thompson, 175 Broadway, N.Y.C.

This invention relates to thermionic devices and a method of operating the same. Its object is to provide for the operation of such a device by means of a current carried only by those negative corpuscles, or electrons, which are emitted from a heated cathode; in particular to insure that no other carriers of electricity shall be furnished by gas ionization taking place in the region between the cathode and the anode under those conditions of operation which are contemplated.

This object has been accomplished by such design and preliminary treatment of the evacuated vessel with its contained electrodes that, for the contemplated method of operation, the number of ionizable gas or vapor molecules remaining as an unavoidable residue after evacuation and other treatment or liberated in the operation of the device, shall be so small that those struck by electrons having the requisite ionization energy shall not contribute more than a negligible part (after ionization) to either the distribution or absolute value of current or volumn density of charge between the electrodes.

By this means are secured certain important advantages in operation which could not be obtained in previous devices of this general type, notably, for example, the ability to so control the electron current, by the use of an auxiliary electrode, that changes so produced in such current shall be accurate and amplified copies of the controlling voltage, with no tendency toward instability and its resultant disturbances which destroy the fidelity of the copy.

This invention will be described more fully in connection with the drawings, in which Fig. 1 represents diagrammatically

a form of thermionic device, showing only the essential features of a typical thermionic device; Fig. 2 is a curve which will be used to explain the operation of thermionic discharge tubes, both with and without gas ionization; Fig. 3 shows a form of thermionic repeater which has been found to be successful in telephony, together with its circuit; Fig. 4 shows an amplifier designed to handle larger amounts of power, at higher voltages, than is necessary or desirable in the case of the telephone repeater; and Fig. 4[a] shows this amplifier associated with an antenna in a radio transmission system. In this figure for the sake of clearness, a simplified diagram of the amplifier of Fig. 4 is shown.

Referring to Fig. 1, 1 represents a cathode which, when heated by current from the battery 5, emits electrons in the manner now well known, and 2 is an anode to which the emitted electrons may be driven. These two elements are enclosed in a vessel 3, which is exhausted. Battery 4, of electromotive force V, is connected between the elements 1 and 2 so as to make 1 the cathode. When the cathode is maintained at a temperature sufficiently high it emits electrons, and by virtue of the electric field established between anode and cathode, these emitted electrons tend to be driven to the anode; whether they actually reach the anode, or are returned to the cathode, depends upon the voltage and the temperature. The number of electrons emitted from a cathode depends upon its area, material and temperature, while the number of these latter which move to the anode, forming the electron current, depends upon the strength of the electric field in the tube, and the latter is determined, for a given tube, both by the voltage of the battery and by the number of electrons in the space, as will

be more fully described later.

Referring to Fig.2, which is a curve showing the relation between the current (I) through the tube and the voltage (V) applied between anode and cathode, the full line curves show the performance of a thermionic device in which the carriers are electrons from the cathode no other ions being present. The reason the curve has this particular form is as follows:

Suppose that the temperature of the cathode is raised to its operating value, the battery being disconnected. The cathode then begins to emit electrons at a rate which depends upon the temperature. The emitted electrons are projected out into the space around the cathode, and consequently produce a negative volume charge throughout that region; but this negative charge tends to repel further electrons coming from the cathode, and in a very short time after the temperature has been raised so many electrons have been thrown into the space that other electrons leaving the cathode are forced back to it as fast as they are emitted. An equilibrium is thus set up in which the volume density of electrification is constant and just sufficient to set up that electric field intensity at the cathode which, on the whole, will prevent more electrons leaving it; that is, in this condition as many electrons are returned to the cathode as are emitted from it.

Now suppose the battery is connected, thus establishing in the tube an electric field tending to draw electrons toward the anode. The electrons making up the volume density mentioned above will be drawn to the anode, other electrons from the cathode take their places, and a current will begin to flow in the tube. At this stage the cathode is capable of furnishing many more electrons than are drawn to the anode.

but is prevented from doing so by the repulsion of the electrons already in the field. The impressed voltage tends to overcome this repulsion, and, as the voltage increases, the current does also, as indicated by the part A of the curve. As the voltage becomes larger the retarding field which is due to accumulated electrons, exerts relatively less influence, and the current increases more rapidly, as at the part B. These two parts are, of course, not separate, being portions of the same curve, which, in practical devices, approximates closely to a parabola.

This process continues with increasing applied voltage until a point is reached at which nearly all the electrons which can be emitted by the cathode, at the given temperature, are drawn away from it and toward the anode. The curve then bends over, as at C, and with still larger voltages all of the electrons which can be emitted from the cathode are drawn away. At this stage, corresponding to the part D in the drawing, no further current can flow from the cathode, no matter how large the impressed voltage may be. This is called the saturation current for the given conditions. This is the curve which would be obtained were it possible to remove all sources of carriers of electricity except the hot electron-emitting cathode.

If the temperature of the cathode, instead of being maintained at the value assumed in the preceding discussion, is raised to a higher value, another curve (OABJK of Fig. 2) is obtained with no gas ionization. In this condition of operation more electrons may be drawn away at any given voltage, and larger currents will be obtained.

The form of either of these curves, before they begin

to bend over as at C or C', and when all the carriers are of one kind as is the case here, was first derived explicitly by C.D. Childs (Phys. Rev., vol. 32, pages 492-511, 1911), who also pointed out explicitly the retarding effect of the carriers making up the volume charge above referred to. His equation shows that in simple cases the curve is of the form

$$I = AV^{3/2}$$

in which A is a constant which depends upon the form of the tube and the physical constants of the carriers. It has been found that, in practical devices employing an extended cathode which is not an equipotential surface, the exponent of V is more nearly 2.

Now suppose a small quantity of ionizable gas or vapor is present, as must be the case in any actual device, since it is obviously impossible to remove all gases and vapors. Whenever a molecule of such gas or vapor is struck by an ion having sufficient kinetic energy, the molecule will be split into a positive and a negative part, that is, it will be ionized by collision. In order that this shall happen it is necessary that the striking ion shall have fallen freely through a certain potential difference, between collisions with neutral molecules, of from 4 to 21 volts, depending upon the nature of the gas. It will be clear that, whenever such a collision takes place, carriers of electricity are produced in the space between the electrodes as well as at the cathode, and since carriers of both signs are produced, some will travel toward the anode and some (the positive) toward the cathode. But these new carriers may themselves produce additional ions by collisions, whenever they happen to strike, with sufficient energy, molecules of gas, and therefore, when ionization by collision takes place, it

results in an increase in current, which, with a further increase in applied voltage, rises suddenly to a relatively large value. In this condition it has been found that the tube is extremely sensitive to changes in external and internal conditions, and that it is unstable in operation.

The value of applied voltage at which this effect starts, and at which the operation of the tube begins to be unstable, depends upon the number of gas molecules in the space; in other words, there is a certain definite relation between the number of gas molecules in the tube and the number and speed of the electrons from the cathode, which determines whether or not there will be appreciable current increase due to gas ionization. This current rise will occur when the gas molecules are so numerous that the number of new ions formed by collision becomes appreciable in comparison with the number of electrons passing from the cathode to the anode. Since the electrons will have greater speed and energy the greater the applied voltage, it is clear that fewer gas molecules are permissible, other things being the same, the larger the applied voltage; for example, in Fig. 2 the dotted portion E of the curve represents the manner in which the operation with no residual gas is modified when a small number of gas molecules is present. If this number is increased, the current rise will occur at some other part F of the curve, corresponding to a lower voltage. If still more molecules are present, the instability may begin at and proceed along the dotted part G.

Now, in using as an amplifier a thermionic device having an auxiliary electrode or grid, it is desirable to operate at the part B of the curve, where the characteristic curve is approximat straight and rising, because within this range amplification

takes place without distortion. For such use, therefore, the gas density must beso small that there shall occur no ionization producing a condition such as that typified by the dotted curve G. If the gas is so far eliminated that the current rise takes place along F or E for example, no trouble will be experienced at the point B. It will, of course, be desirable to so treat the tube that the current rise E or F) shall occur at voltages enough higher than the operating voltage (V_1) to insure a reasonable margin of safety for those accidental increases in voltages or changes in vacuum which are likely to occur in practice.

If the temperature of the cathode is so adjusted that the upper curve K of Fig. 2 is obtained, and if the operation as an amplifier is to take place on the steep and approximately straight part J of this curve, it will be clear that a tube somewhat better prepared to hold it vacuum will be necessary to secure the same margin of safety as in the case of operation at the corresponding point B of the lower curve, because the operating voltage and the number and kinetic energy of the electrons are greater at the higher temperature than at the lower.

On the other hand, if the device is to be used as a detector, that is, depending upon the rectification of the currents produced by small variations in voltage, it is necessary to operate at a point at which the characteristic is curved, for no rectification can be effected on a straight characteristic by producing changes in the applied voltage. This is because, using a straight characteristic, a positive increment of voltage, added to the normal operating voltage, produces the same change in current as does an equal negative increment, and the average change in current is therefore zero; while if the slope of the characteristic is changing in the

neighborhood of the normal operating voltage, the effects due to such increments are not equal, and an average current different from zero is obtained. For the purpose of detecting small oscillations, such as occur in wireless telegraphy, it may therefore be desirable to utilize the curve OAG, which is obtained when much more gas is present than could be tolerated in an amplifier. In that case, the detector could be operated at the point H where the curvature, due to impending instability, is considerable. In this case it will, of course, be necessary to maintain accurate adjustment of applied voltage to guard against excessive ionization, or "hazing" in the tube. This was the condition of operation of the original DeForest audion, as a detector, and it introduced troubles due to excessive ionization when the attempt was made to employ it in telephone circuits, in which the changes in voltage are much larger.

It has been found that the device may be used efficiently as a detector, without the use of gas ionization and consequent instability, by operating on a curved part (A or C) of the curve of Fig. 2.

A further disadvantage resulting from allowing appreciable gas ionization is that the positive carriers so produced may be drawn to the cathode with sufficient energy to break it down.

The fact that electrons emitted from a heated filament will act, without gas ionization, to carry the current between the cathode and the anode, has long been a matter of scientific knowledge, but prior to this invention, so far as is known, no practical advantage had been taken of this fact. It has been commonly supposed that the electrons thus emitted must be utilized to ionize the residual gas in

the vacuum tube in order that the device might operate efficiently. The DeForest audion, according to the printed description thereof by its inventor, (See Proc. A.I.E.E., and vol. 25, p. 735, 1905)/according to the patents therefor (U.S. patents Nos. 841,387 and 879,532) depends upon the principle of gas ionization. The same is also true of the Fleming detector (see the statement contained in U.S. patent No. 954,619). In accordance with the present invention, high voltages, without gas ionization, can be employed by exhausting the tube to a high degree, and the degree of exhaustion necessary may be determined by the uses to which the thermionic device is to be put. For example, where the device is to used as a telephone repeater or amplifier, in which the voltages employed do not ordinarily exceed a value of 200 volts, the degree of exhaustion need not be so high as that required where the devices are to be employed for furnishing energy in wireless transmission. In this latter case, when suitable precautions are taken to denude the walls and contents of the tube of occluded gases, it has been found that a vacuum in which the pressure is one millionth of one millimeter ~~10 6~~ of mercury will suffice, such vacuum being sufficiently high to prevent gas ionization with voltages in the neighborhood of 600 volts and still afford a wide margin of safety. If extreme precautions are taken for denuding the vessels and its contents of occluded gasses, much less perfect initial vacua will suffice. In case still higher voltages are to be employed, precaution should be taken to obtain and maintain the vacuum so high as to make the possibility of gas ionization negligible. Aside from the increased difficulty and expense involved in the manufacture of such tubes, it would, of course, be desirable to have the tubes of this invention exhausted to the highest possible vacuum.

In order to secure the relations required in thermionic devices of this invention, it has been found that certain methods of treatment and operation of the device are necessary, which methods will be described in connection with Fig. 3 of the drawing, which represents a form taken by a three-element thermionic repeater for telephony, and Fig. 4 which shows a form of amplifier adapted to work at higher voltages and to deliver larger amounts of power, and which, for example, has recently been used successfully in long distance radio telephony from Washington, D.C., to Honolulu, to Mare Island, California, and to Paris.

Referring to Fig. 3, 1 represents the filamentary cathode which may be heated by means of battery 5, 2 is a double anode, so constructed as to utilize efficiently electrons from all parts of the filament, and 3 is a glass containing vessel. The double grid structure 6 is introduced to control the current in the tube, which is set up by battery 4, in response to voltages impressed upon the grid-filament circuit (input circuit) from the secondary side 7 of the transformer 7-8, whose primary 8 receives power from an incoming line. The plate-filament circuit (output circuit) contains the winding 9 of a transformer whose other winding 10 is connected to the outgoing line. The object of the battery 11 is to maintain the grid at a negative potential with respect to the filament; in this condition (since only negative carriers are present) no current can flow to the grid, and the input impedance of the tube is infinite, that is, the amplifier is a voltage-operated device, consuming practically none of the energy of the input circuit. Because of this fact, it is desirable to add a resistance 12, of about half a million ohms, across the input circuit to permit efficient transfer of power with a finite transformer

ratio.

The electromotive force of the battery 4 is, in practice, about 130 volts, and it is therefore necessary as stated previously, so to prepare the tube that no appreciable gas ionization shall take place during evacuation at voltages considerably higher than this value. In this preparation the tube is evacuated, preferably with a molecular pump, using the precautions necessary in this kind of work, and impressing between anode and cathode a voltage about twice that used in normal operation. The effect of this is to subject the tube to more rigorous treatment than it will obtain in practice, and consequently to insure that gases remaining occluded in the walls and electrodes after this treatment will not be driven out during the practical operation of the tube. This process of pumping and ageing the tube is carried on until no gas ionization can be detected.

Referring to Figs. 4 and 4-a in which parts similar to those of Fig. 3 are denoted by like numerals, 1,2,3,6 denote an amplifier designed to deliver large amounts of power. In practice, several of these are connected in parallel.

Since these tubes are designed to operate at about 600 volts, a direct current generator 4' is used instead of the battery 4 of Fig. 3; it is connected across the terminals of the larger condenser 13 which acts as a good conductor to high frequency currents in the output circuit, which latter is coupled, by means of the transformer 9-10, to the antenna.

A tuned circuit 7-14 is included in the input circuit, and oscillations of varying amplitude are impressed upon that tuned circuit from any suitable modulating system (not shown) connected to the terminals of coil 8.

According to this invention, this high power amplifier

is operated under those conditions in which an inappreciable number of positive gas ions is produced, namely, at or near the point B of the lower curve of Fig. 2, or the point J of the upper curve, the preliminary treatment having been such as to insure that no instability, due to ionization, shall take place except at considerably higher values of impressed voltage and power output

It will be understood that the operating voltage of 600 volts has been given merely by way of illustration, and that it may, and undoubtedly will, be convenient to employ much higher voltages.

That I claimed is:

1. A thermionic amplifier comprising a vacuum tube, a heated electron-emitting cathode and an anode enclosed in said tube, a circuit outside of said tube connecting said anode and said cathode, and a source of direct current included in said circuit, the voltage of said source being so proportioned to the degree of the vacuum and the temperature of the cathode of said tube that the current between said cathode and anode is carried approximately exclusively by the electrons emitted by said cathode.

2. In a thermionic device, a vacuum tube, a heated electron-emitting cathode and an anode enclosed in said tube, a circuit outside of said tube connecting said cathode and anode, and a source of direct current included in said circuit, the vacuum in said tube being so high that no sudden increase in current due to gas ionization is possible except at voltages higher than that required to produce the saturation current at the operating temperature of the cathode.

3. In a thermionic device, a vacuum tube, a heated electron-emitting cathode and an anode enclosed in said tube, a circuit outside of said tube connecting said cathode and anode, and a source of direct current included in said circuit, the vacuum in said tube being so high that a working margin of safety exists between the voltage at which all electrons capable of being emitted by the filament at the temperature at which the latter is maintained flow to the plate and the voltage at which there

is appreciable ionization of the residual gas of said tube.

2 6. The method of controlling the current in a vacuum tube having a heated cathode and a plate and a circuit including a source of direct current connecting said cathode and plate, which method consists in so proportioning the voltage of said source of current with respect to the temperature of the cathode and the degree of the vacuum in said tube, that the current varies approximately in accordance with the Child equation up to the voltage beyond which there is no appreciable increase of current with increased voltage, and in operating said tube at a voltage below that for which the current ceases to increase appreciably with increased voltage.

3 6. The method of preliminary treatment and subsequent operation of a thermionic device, which consists in subjecting it, during evacuation, to a voltage and temperature considerably higher than the normal operating voltage and temperature, in this condition evacuating said device until no ionization is produced; and subsequently operating it at the normal operating voltage and temperature.

4 6. In a thermionic repeater, a vacuum tube, a heated electron-emitting cathode, an anode and an auxiliary electrode in said tube, a circuit outside of said tube connecting said cathode and said auxiliary electrode, said circuit containing a source of electromotive force whereby the auxiliary electrode is maintained at a negative potential with respect to the cathode; a circuit connecting said cathode and anode, and a source of direct current in-

cluded in said latter circuit, the vacuum in said tube being so high that a margin of safety exists between the voltage at which all the electrons capable of being emitted by the filament at the temperature at which the latter is maintained flow to the plate and the voltage at which there is perceptible ionization of the residual gas of said tube.

Per A
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as a
repeater
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7. The method of operating a thermionic device comprising a heated cathode, an anode and an auxiliary electrode, which methc* consists in providing in said device a vacuum so high that at the voltage employed between the cathode and the anode there is no appreciable ionization of the gas or vapor in the vacuum of said device, and impressing electric currents to be repeated on a circuit including the heated cathode and the auxiliary electrode, and establishing a circuit including the cathode and the anode, in which circuit said currents are repeated.

5 R.R. A repeater of the thermionic type having an output circuit including a source of current so proportioned with respect to the degree of the vacuum and the temperature of the cathode of said repeater that there is no appreciable gas ionization in said repeater.

do!

6 R.R. In the construction of a vacuum tube amplifier of the thermionic type, the step which consists in obtaining such a vacuum that the ionization voltage for that vacuum, under the working conditions of said tube, shall be above the working voltage to be impressed upon said tube.

do!
Too highly
exhausted
X Ray

7 R.R. A thermionic tube device, having its filament and the degree of its vacuum so proportioned to the

do!
Too highly
exhausted
X Ray

voltage to be impressed that no appreciable gas ionization takes place.

8. ~~10.11.~~ The method of operating a vacuum tube device of the thermionic type, which consists in so relating the temperature of the filament to the vacuity and impressed voltage that no appreciable ionization takes place.

dw 1

Too highly ethereal X Ray

Read

dw 1

~~11. 12.~~ A vacuum tube device of the thermionic type, having the area of the filament and the degree of vacuity so related to the temperature and the impressed voltage at which the tube is to be worked that no appreciable ionization takes place when substantially all the electrons emitted are drawn to the anode.

9. ~~12. 13.~~ A thermionic device wherein an electron discharge takes place between a heated cathode and an anode in a vacuum, the degree of said vacuum being so coordinated with the volume and velocity of said discharge that no gas ionization can occur during normal operation.

just part. over Thermion. work

dw 1

10. ~~13. 14.~~ A thermionic device comprising a heated cathode and an electrode, an evacuated vessel enclosing the same, an external source of electromotive force so applied as to maintain said electrode positive with respect to said cathode, the degree of vacuum within said vessel being sufficiently high to insure that no appreciable gas ionization will be produced by said electromotive force.

do 1

11. ~~14. 15.~~ The method of treating a thermionic device having a heated electron-emitting cathode and an anode enclosed within an evacuated vessel to insure the stable operation thereof, which method consists in applying a potential difference between said cathode and said anode during the

do 1

66/17

process of evacuating said vessel and carrying the evacuation to a point where no gas ionization is produced at said potential difference, said potential difference being sufficiently greater than the potential difference to be employed in the normal operation of the device to insure a working margin if safety for said operation.

12. A vacuum tube comprising a heated cathode and an anode in an evacuated vessel, an external source of electromotive force connected between said anode and cathode, the temperature and area of said cathode being so proportioned to the vacuum in said vessel and to the voltage of said source that when approximately all the electrons emitted by the cathode are drawn to the anode there shall be no appreciable ionization of the residual gas in said tube.

Insert B'

HWB-R
AT
EM

In Witness Whereof, I ..... hereunto subscribe my name ——this first day of November A. D., 191 5

Harold DeForest Arnold

WITNESSES:

State of New York }
COUNTY OF New York } ss:

HAROLD DeFOREST ARNOLD

the above named petitioner, being duly sworn, deposes and says that he is a ..... citizen of the United States, and resident of East Orange in the County of Essex and State of New Jersey and that he verily believes himself to be the original, first, and sole inventor of the improvement in THERMIONIC DEVICES AND METHOD OF CONSTRUCTING AND OPERATING THE SAME

described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in the United States of America or any foreign country before his invention or discovery thereof; or more than two years prior to this application; or in public use or on sale in the United States for more than two years prior to this application and that no application for foreign patent has been filed by him or his legal representatives or assigns in any foreign country.

Harold DeForest Arnold

Sworn to and subscribed before me this first day of November 1915

Clark Williams

Notary Public.

1139

MAIL ROOM
NOV 10 1915
U.S. PATENT OFFICE

PAPER NO. 6
LETTER

UNITED STATES PATENT OFFICE.

In matter application
Harold D. Arnold,
Serial No. 59,210,
filed November 2, 1915.

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

The attention of the Primary Examiner is respectfully directed to the similarity of subject-matter which apparently exists between this application and an application of Irving Langmuir, Serial No. 795,610, filed October 16, 1913, which is referred to in the recently issued patent to William C. White, No. 1,159,302, dated November 2, 1915.

It is respectfully requested that any allowable claims of the Langmuir application which could be made by Arnold should be suggested to him for the purposes of interference.

Applicant further wishes to call the attention of the Examiner to the specification of British patent No. 15,788 of 1914 to the British Thomson-Houston Company, Limited, and it is requested that if claims to subject-matter similar to that claimed in the said British patent have been presented by other applicants in the United States Patent Office, and found allowable, such claims should be suggested to Arnold.

Respectfully submitted,

Attorney for Harold D. Arnold.

463 West Street, New York, N.Y.
November 18, 1915.

Div. 14 Room 109
Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

Please Mr. ____
All communications concerning this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Apr. 18, 1916.

U.S. PATENT OFFICE
APR 18 1916
MAILED

Mr. John C. Roberts,
463 West Street,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

H. Def. Arnold, S. No. 59,250, filed Nov. 2, 1915. Thermionic Devices and Method of Constructing and Operating the Same.

Thomas Ewing
Commissioner of Patents.

This application has been examined.

The letter filed Nov. 19, 1915, has been made of record.

Page 4, lines 10 and 25, which battery? Line 26, correct the spelling of "establishing".

Page 8, line 13, which curve is meant by "upper curve".

Page 10, line 20, the pressure should be definitely specified, as "10-6 mm" is not understood.

Page 11, line 14, pluralize the last word.

The following art is made of record:

Hull, 1,114,697, Oct. 20, 1914, 179-171,
White, 1,159,307, Nov. 2, 1915, 250-27,
British patent, 15,788 of 1914, (3 sheets), 250-27,
Proceedings of Institute of Radio Engineers, Vol. 3, No. 3, Sept. 1915. Article by Langmuir at page 261, entitled "Pure Electron Discharge". See Figures 4, 5 and 6,
General Electric Review, May, 1915. Article on "Pure Electron Discharge", by Langmuir. See Figures 3, 4, 5 and 6,
Physical Review, (New York), Vol. 2, 1913, page 409, Article by W. D. Coolidge entitled "A Powerful Rontgen Ray Tube", See Figs. 1, 2 and 3,
"Conduction of Electricity Through Gases", by J. J. Thomson, Cambridge University Press, 1908. See pages 192 and 193 and related matter in Chapter VIII, especially Figure 41,

British patent, 14,892 of 1913, (1 sheet), 250-34, Note Figures 1 to 8, inclusive,
French patent 462,512, (1 sheet), 250-35

Claims 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14 and 16 are rejected on each of the patents to Hull and White, above.

Claims 1, 2, 3, 4, 5 and 7 to 16, inclusive, are rejected on each of the references to British patent 15,788 of 1914, Proceedings of Radio Engineers and General Electric Review.

Claims 1, 2, 3, 4 and 9 to 14, inclusive, and 16 are rejected on each of the references to Physical Review, Conduction of Electricity Through Gases, British patent 14,892 of 1913, and French patent, 462,512.

It may be stated that in Hull the anode is number 6, the cathode number 2 and the source of direct current is shown at 13.

In "Conduction of Electricity through Gases" the examiner reads the filament AB as the cathode and the metal cylinder as the anode. The source of direct current is described but not illustrated. Note that at the end of article 103 the absence of ionization of gas is expressly mentioned.

Claim 6 is rejected on each of the references above cited in view of Arnold, 1,125,280, Feb. 16, 1915, 250-27, who shows the well known idea of using a source of electromotive force to maintain the auxiliary electrode at a potential negative with respect to the cathode.

Claim 7 is rejected as being no method, but a mere recitation of the manufacture and use of the

59,210 — 3.

article claimed in the other claims.

Claims 9, 10 and 11 are broad enough to cover any ordinary X-ray tube when its vacuum increases to such a degree that it must be reduced to enable it to operate, as commonly occurs.

Applicant's letter calling attention to an alleged application of Langmuir and also to a British patent is noted and if applicant desires an interference in this case it will be necessary for him to overcome under Rule 75 or otherwise the art cited against his claims, and he is given thirty (30) days from the date of this letter within which to make such showing.

The claims are all rejected.

GLP

Wm A Kinnan

Examiner, Division XVI.

1143

MAIL ROOM MAY 12 1916 U.S. PATENT OFFICE

PAPER NO 4
AMENDMENT A
+ affdt.

UNITED STATES PATENT OFFICE
DIVISION 16 - Room 100

In re application of
Harold D. Arnold
Serial No. 59,210
Filed November 2, 1915

Thermionic Devices and Method of Constructing and Operating the Same.

PATENT OFFICE ☆ MAY 12 1916 ☆ DIV 16 FILED

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of April 18, 1916, please amend the above entitled application as follows:

Page 2, line 5, cancel "the" and insert --a--.

Page 4, line 10 and line 26, after "battery" insert the numeral --4--.

Page 8, line 13, after "curve" insert --K--.

Page 10, line 20, cancel "10-6 mm." and substitute --one millionth of one millimeter--.

Page 11, line 14, pluralize "electron".

Cancel claim 7, and renumber remaining claims.

REMARKS

The Office action rejecting the claims on various domestic and foreign patents and on certain publications has been duly considered, and the applicant files herewith an affidavit which, under Rule 75, overcomes all references cited against the claims, with the exception of the Thomson publication.

(Serial No. 59,210)

As regards the rejection of claims 1 to 4, 9 to 14 and 16 on Thomsen, the following is submitted: It is not denied that the reference cited contains a clear scientific statement of the theory of electronic emission from heated metals in vacuo together with corroborating results of experiment. It is, however, emphatically denied that the reference suggests or remotely hints at the utilization of the pure electron discharge in a device useful in the art. The facts of the case are as follows: In 1903 Richardson advanced his theory of thermionic emission from heated metals in vacuo without the agency of any residual gases. This theory was not immediately accepted and indeed certain experiments, notably those of H. A. Wilson, seemed to rather discredit it, the question hinging not on the fact of emission per se, but as to whether residual gases were essential, directly or indirectly, to the liberation of electrons. It may be mentioned that it is only within the past two or three years that Richardson's theory has been established on a reasonably certain basis. In the reference cited, Thomsen, in order to investigate the phenomena of thermionic emission per se did the obvious thing, namely, he eliminated the effects of gas action by as complete removal of the gases as possible. He found that the residual gas could not be completely removed with the methods of evacuation at his disposal, and, as stated in the last paragraph of the reference cited, that if the voltage was raised beyond a certain point the true phenomena of thermionic emission were masked by ionization of the residual gas. Thus the reference cited is a purely scientific statement of some of the laws governing vacuum phenomena with absolutely no suggestion of their embodiment in devices useful in the art.

(Serial Nos. 59,210)

The art will now be considered. In spite of the fact that Richardson's theory of thermionic or pure electronic emission was advanced in 1903 and was accepted by the majority of physicists, the whole trend of the art was to utilize the phenomena of ionization rather than pure thermionic emission. Indeed this was the obvious and straightforward course, since it was known and is known that much larger currents are obtainable in a given vacuum tube working with ionization than in the same tube when highly evacuated. To mention only a few examples of the art, the Fleming rectifier, the Von Lieben and Reisz relay, the mercury arc rectifier of Hewitt and the audion of DeForest, these, as explicitly stated in the patent office disclosures of the several devices, all avowedly work on gas ionization. This is not at all surprising since, for certain uses, the presence of gas may be desirable and larger energy output made possible thereby. It remained for the applicant to discover that for certain uses, notably for the three element repeater or amplifier, the presence of gas ionization is highly deleterious and that the disadvantage due to reduction of current volume, consequent upon absence of ionization, was more than compensated for by definite advantages attaching to the pure electron discharge. He was the first to discover that the point at which ionization sets in, mentioned as a purely scientific observation by Thomson, was precisely the point at which satisfactory operation ceased. Thomson, indeed, states that under the experimental conditions he worked with, ionization sets in when the voltage was increased beyond a certain value; he does not anywhere state that the ionization point depends in a complicated way on the degree of vacuum and the temperature of the filament and nowhere hints that such ionization is highly

deleterious to the operation and life of the practical devices utilizing the phenomena of thermionic emission. Finally he does not anywhere even remotely hint or suggest that the point at which appreciable ionization sets in is precisely the point at which rectification in the two element device and repeater action in the three element device becomes imperfect. It is contended broadly that the mere statement of a scientific fact does not preclude subsequent invention when advantage of said scientific fact is taken to provide a practical device useful in the art. The discovery of the law of induction by Faraday carried with it the whole theory and operation of the transformer, yet it is surely not contended that the production of the transformer and the dynamo did not involve inventive thought.

Furthermore, as to claims 1, 4, 10, 11, 12 and 16, it is submitted, and again emphasized, that Thomson does not anywhere make mention of the fact that there is any relationship between the temperature of the filament and the ionization within the tube. The mere statement that the effects observed show that the electrification around an incandescent wire is a complicated phenomenon and depends, among other things, on the temperature, or that the saturation current depends on the filament temperature is not to the point. These claims are for entirely new matter so far as the reference is concerned in that they point out the importance of suitably adjusting the filament temperature to avoid ionization, and they should, it is urged, be allowed.

As to claim 9, it is submitted that, in addition to the reasons given above, Thomson is not a reference. It is admitted that Thomson performed the step of obtaining such a vacuum that the ionization voltage for that vacuum was above the working voltage impressed on his tube. But such a step

1146

(Serial No. 59,210)

has been taken in any and all discharge tubes in which ionization is not present. The applicant, however, is the first to use this step in the construction of a certain article specified in the claim; namely, a vacuum tube amplifier of the thermionic type.

As to claims 12 and 13, no mention is made by Thomson of the effect of the area of the filament or of the volume of the discharge upon the ionization.

It is thought that the above arguments regarding Thomson are such as to warrant the allowance of the claims rejected thereon. An affidavit has been filed which overcomes all other references. It appears, therefore, that this application is in condition for allowance.

Respectfully submitted,

HAROLD D. ARNOLD,

By H. C. Hamer

Attorney

463 West Street,

New York, May 11, 1916.

PMC
EHC

MAIL ROOM MAY 12 1916 U.S. PATENT OFFICE

#4

IN THE UNITED STATES PATENT OFFICE

Harold D. Arnold

Thermionic Devices and Method of Constructing and Operating Same

Filed November 2, 1915

Serial No. 59,210.

PATENT OFFICE MAY 13 1916 REC'D & FILED

AFFIDAVIT OF HAROLD D. ARNOLD

State of New York)
County of New York) ss.

HAROLD D. ARNOLD, being duly sworn, deposes and says:

I am the applicant in the above entitled case.

The subject matter of the claims therein I conceived, described, embodied in full size operating apparatus and disclosed to others prior to December, 1913 as described in detail hereinafter, it being understood that the dates specified may not be the earliest dates of work on my invention by myself or my assistants.

The invention as embodied in the claims resulted from experimental work carried on by myself and my assistants in the laboratories of the Western Electric Company. The result of this experimental work is contained in laboratory note books, and various memoranda now in the archives of said Company. These note books and memoranda show that I first found that when the three element device, commonly called the audion, worked efficiently as a repeater or amplifier, the action was purely electronic, and that the presence of ionization was deleterious, as indicated by the poor quality of reproduction of the input voltage, as soon as gas ionization appeared. The

audion tubes which were available at and prior to the time of these first experiments were evacuated to the then customary degree, and the maximum D.C. plate voltage which could be applied without production of ionization was in the neighborhood of 40 volts, and if this voltage was exceeded, the reproduction, that is, the usefulness of the tube as a repeater, was impaired. The result of theoretical considerations taken in connection with this early experimental work, led me to believe that higher plate voltages could be used and correspondingly larger output currents obtained without ionization by using a higher vacuum. A molecular pump was therefore ordered, and immediately upon its arrival tubes were evacuated therewith to the highest possible degree. It was found that a very much higher plate voltage could then be used, that no gas ionization was present at the highest voltage tried, that the output current was much larger, and that in this case a good reproduction of the input voltage was obtained up to the maximum voltage tried. In all these tubes, however, faithful reproduction of the input voltage was obtained so long as the voltage, filament temperature and vacuity were so related as to avoid the presence of any ionized gas in the tube. This experimental work was carried on, the memoranda and note book records were made, and the invention was reduced to practice prior to December, 1913, and the said invention is now in public use.

The subject-matter of the claims herein was not in public use or on sale in this country for more than two years prior to the date of said application so far as my present knowledge or information extends, and has never been abandoned by me.

Harold D. Arnold

Subscribed and sworn to
before me this 5th
day of May, 1916.

Edward E. Williams
NOTARY PUBLIC
NEW YORK CO. NO 337
NEW YORK REGISTER NO 91..

New York, N. Y.

INC LIB CO

Div 16 Room 109

Paper No. 5

Copy sent assignee and applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE

WASHINGTON, June 15, 1916.

U. S. PATENT OFFICE
JUN 15 1916
MAILED

Mr. John G. Roberts,
465 West Street,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

H. DeF. Arnold, S. No. 59,210, filed May 2, 1915,
Thermionic Devices and Method of Constructing and Operating the Same.

Thomas Ewing
Commissioner of Patents.

This action is in response to amendment filed May 13, 1916.

The following claims are suggested to applicant for purposes of interference. Applicant is given twenty days from date of this letter within which to present them. Failure to present such claims within the time stated will be held an abandonment of their subject-matter.

An electrical discharge device comprising a gas-tight envelope, an incandescent cathode, and a gas-free anode, the space in said envelope being evacuated to below the pressure at which deleterious gas ionization takes place, the current passed by said device over a working range of voltage and temperature varying with the 3/2 power of the impressed voltage for voltages above a minimum voltage depending on the temperature of the cathode.

A high vacuum electron discharge device comprising an envelope, an incandescent cathode, and an anode, the space in said envelope being evacuated to such degree that the passage of current produces no appreciable positive ionization when the impressed voltage is as high as 800 volts.

An electrical discharge device comprising a gas-tight evacuated envelope, a cathode adapted to be heated to incandescence, an anode, the space in said envelope being evacuated to such a degree that the current flowing between said electrodes varies with the 3/2 power of the impressed voltage over a working range of current values exceeding about five milliamperes

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59,810 — 2.

An electrical discharge device comprising a gas-tight envelope, an incandescent cathode, an anode, and means for independently heating the cathode, the parts of said apparatus and the enclosed space being deprived of gas to such extent that the device is operable with currents varying with the 3/2 power of the voltage over a range of impressed voltages determined by the cathode temperature, the current at voltages above this range being substantially constant.

Chas A Kinnan

Examiner, Division XVI.

PAPER No. 6
AMENDMENT B

MAILROOM JUN 28 1916 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE
Division 16 - Room 109

In re application of
Harold D. Arnold
Serial No. 59,210
Filed November 2, 1915

Thermionic Devices and Method of Constructing and Operating the Same.

PATENT OFFICE JUN 29 1916 DIV 16 FILED

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Please amend the above entitled application by adding the following four claims as claims 16 to 19 inclusive:

--16. An electrical discharge device comprising a gas-tight envelope, an incandescent cathode, and a gas-free anode, the space in said envelope being evacuated to below the pressure at which deleterious gas ionization takes place, the current passed by said device over a working range of voltage and temperature varying with the 3/2 power of the impressed voltage for voltages above a minimum voltage depending on the temperature of the cathode.

13 ~~12~~. A high vacuum electron discharge device comprising an envelope, an incandescent cathode, and an anode, the space in said envelope being evacuated to such degree that the passage of current produces no appreciable positive ionization when the impressed voltage is as high as 200 volts.

(Serial No. 89,210)

18. An electrical discharge device comprising a gas-tight evacuated envelope, a cathode adapted to be heated to incandescence, an anode, the space in said envelope being evacuated to such a degree that the current flowing between said electrodes varies with the 3/2 power of the impressed voltage over a working range of current values exceeding about five milliamperes.

19. An electrical discharge device comprising a gas-tight envelope, an incandescent cathode, an anode, and means for independently heating the cathode, the parts of said apparatus and the enclosed space being deprived of gas to such extent that the device is operable with currents varying with the 3/2 power of the voltage over a range of impressed voltages determined by the cathode temperature, the current at voltages above this range being substantially constant.--

REMARKS

The above claims are those suggested to applicant for the purpose of interference in Office action of June 15, 1

Respectfully,

HAROLD D. ARNOLD

By [signature]

Attorney.

443 West Street,

New York, June 27, 1916.

64/3

INTERFERENCE.

Interference No. 40380 Paper No. 7

Name. Harold W. F. Arnold

Serial No. 59,210

Title, Thermionic Devices and Methods of Constructing and Operating the Same

Filed. June 2, 1915

Interference with J. Langmuir

DECISIONS OF

Primary Examiner Judgment dismissed as to counts 1, 2, 3, 4, 6, 7 Dated, Feb. 25, 1921

Ex'r of Interferences, Adverse Dated, Oct. 21/24

Board. Dated, April 21/25

Commissioner. Favorable Dated, OCT 27 1926

Court. Adverse Dated June 1. 1927

REMARKS:

Termination of Int. noted by P. E.

July 11. 1928

No change to be placed in any application or patent involved in interference by an Office in the interference below the Primary Examiner.

1155

Forwarded from Ex. 16 to Examiner of Interferences.

2-213

Paper No. 8

[INTERFERENCE.]

July 31, 1916.

DEPARTMENT OF THE INTERIOR.

P.H.

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C.

Copy sent assignee.

U. S. PATENT OFFICE,
INTERFERENCE DIVISION
AUG 8 1916
MAILED

Mr. John C. Roberts,

463 West Street,

New York, N. Y.

Please find below a copy of a communication from the Examiner concerning the

application of Harold DeF. Arnold, S. No. 59,210, filed Nov. 2, 1915, Thermionic Devices and Method of Constructing and Operating the Same.

Room No. 309

ADDRESS ONLY THE COMMISSIONER OF PATENTS WASHINGTON, D. C.

Very respectfully,

Commissioner of Patents.

40380

The case, above referred to, is adjudged to interfere with others, hereafter specified, and the question of priority will be determined in conformity with the Rules.

The statement demanded by Rule 110 must be sealed up and filed on or before SEP 5 1916 *, with the subject of the invention, and name of party filing it, indorsed on the envelope. The subject-matter involved in the interference is*

1. In a thermionic device, a vacuum tube, a heated electron-emitting cathode and an anode enclosed in said tube, a circuit outside of said tube connecting said cathode and anode, and a source of direct current included in said circuit, the vacuum in said tube being so high that no sudden increase in current due to gas ionization is possible except at voltages higher than that required to produce the saturation current at the operating temperature of the cathode.

2. In a thermionic device, a vacuum tube, a heated electron-emitting cathode and an anode enclosed in said tube, a circuit outside of said tube connecting said cathode and anode, and a source of direct current included in said circuit, the vacuum in said tube being so high that a working margin of safety exists between the voltage at which all electrons capable of being emitted by the filament at the temperature at which the latter is maintained flow to the plate and the voltage at which there is appreciable ionization of the residual gas of said tube.

3. A vacuum tube device of the thermionic type, having the area of the filament and the degree of vacuity so related to the temperature and the impressed voltage at which the tube is to

be worked that no appreciable ionization takes place when substantially all the electrons emitted are drawn to the anode.

4. An electrical discharge device comprising a gas-tight envelope, an incandescent cathode, and a gas-free anode, the space in said envelope being evacuated to below the pressure at which deleterious gas ionization takes place, the current passed by said device over a working range of voltage and temperature varying with the 3/2 power of the impressed voltage for voltages above a minimum voltage depending on the temperature of the cathode.

5. A high vacuum electron discharge device comprising an envelope, an incandescent cathode, and an anode, the space in said envelope being evacuated to such degree that the passage ofcurrent produces no appreciable positive ionization when the impressed voltage is as high as 300 volts.

6. An electrical discharge device comprising a gas-tight evacuated envelope, a cathode adapted to be heated to incandescence, an anode, the space in said envelope being evacuated to such a degree that the current flowing between said electrodes varies with the 3/2 power of the impressed voltage over a working range of current values exceeding about five milliamperes.

7. An electrical discharge device comprising a gas-tight envelope, an incandescent cathode, an anode, and means for independently heating the cathode, the parts of said apparatus and the enclosed space being deprived of gas to such extent that the device is operable with currents varying with the 3/2 power of the voltage over a range of impressed voltages determined by the cathode temperature, the current at voltages above this range being substantially constant.

The interference involves your application above identified and

An application for Electrical Discharge Apparatus and the Process of Preparing the Same, filed by Irving Langmuir, C/o General Electric Co., Schenectady, N. Y., whose attorney is Albert G. Davis, C/o General Electric Co., Schenectady, N. Y., and whose assignee is the General Electric Co., Schenectady, N. Y.

The relation of the counts of the interference

to the claims of the respective parties is as follows:

Counts:	Arnold:	Langmuir:
1	2	20
2	3	21
3	11	22
4	16	4
5	17	5
6	18	9
17	19	16

Wm. Aikman
Examiner, Division XVI.

Paper No. 14
Amend. C.

UNITED STATES PATENT OFFICE.

Division 16. Room 100.

Harold D. Arnold
Serial No. 59210
Filed November 2, 1915

Invention: Thermionic Devices and Method of Constructing and Operating the Same.

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

By the present letter, amendments are made in response to the suggestion contained in the last paragraph of the Inter partes decision by the Law Examiner on February 25, 1921, and this occasion is taken to make certain further amendments, believed to be appropriate at this time, and for which the applicant now respectfully make leave.

Page 7, line 5, change "rises" to -- may rise --; line 9, after "space" insert -- and occluded in the electrodes, inner tube walls, etc. --; line 24, after "present" insert -- , as by liberation from the electrodes or tube walls by the energy dissipated in the tube --; line 27, after "present" insert -- or are readily liberated in the tube --.

Page 8, line 1, after "distortion", insert -- In this case the abscissa of the diagram, Figure 2, may not represent the mere plate potential, but it may combine the plate and grid potentials in the proper properties. --; line 16, change "somewhat better" to -- tube somewhat better prepared to hold its --.

1159

Add the following claims:

14. An electrical device comprising the combination of a sealed evacuated envelope, a cathode adapted to be independently heated, and an anode within said envelope, an external circuit connected to said electrodes, and a source of electro-motive force applied to said circuit, the degree of vacuity and the electron emission of the cathode being so related to the potential of said source that the flow of current over a range of voltage materially above the ionization voltage is governed by the electric field of the electrons in the vacuous space and the potential applied to said electrodes, operatively independent of gas ionization.

15. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the governing or limiting action on the space current due to the electric field of said electrons is substantially unaffected by positive ionization and by secondary electron emission from the walls of the tube.

16. A discharge tube having a cathode adapted to emit electrons and an anode adapted to receive said emitted electrons, the tube walls being fashioned or shaped to permit direct passage of a useful proportion of said electrons from cathode to anode, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the space current is governed or limited by the electric field of said electrons substantially unaffected by positive ionization.

17 23. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that in that range the space current is governed by the combined effect of the electric field of said electrons and the potentials applied to said electrodes, the governing or limiting of the current being substantially unaffected by positive ionization and by secondary electron emission from the walls of the tube.

18 24. A discharge device comprising a tube and electrodes therein one of which is adapted to emit electrons, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed upon electrodes of the device and when the electron emission has any values such that the space current is below the saturation region at such voltages, that the slope of the line obtained by plotting the logarithms of values of said current as ordinates against the logarithms of the corresponding values of said impressed voltages as abscissas shows no increase for increasing voltage values.

19 25. A discharge device comprising a tube and electrodes therein one of which is adapted to emit electrons, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the device and when the electron emission has any value such that the space current is below the saturation region at such voltages, that

the line obtained by plotting the logarithms of any values of said current below the saturation region as ordinates against the logarithms of the corresponding values of said impressed voltages as abscissae is straight and continuous.

20 86. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated when voltages materially higher than ionization voltages are impressed on electrodes of the tube and when the electron emission has any value such that the space current is below the saturation region at such voltages, that said current varies as the three halves power of said impressed voltages.

21 87. A discharge device comprising a tube and electrodes therein one of which is an electron emitting cathode, the degree of evacuation of said device and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the device and when the electron emission is such that the space current is below the saturation region at such voltages, that said current is substantially independent of the cathode temperature and unaffected by secondary electron emission from the walls of the tube.

22 88. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the space current is governed or limited by the combined effect of the electric field of said electrons

and the potentials applied to said electrodes, substantially unaffected by positive ionization, the heating effect in the tube due to said current occuring substantially only at one or more of said electrodes.

23 30. A discharge tube having a cathode adapted to emit electrons, an anode adapted to receive electrons and tube walls fashioned or shaped so as to permit the free passage of a useful proportion of said electrons from cathode to anode, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of operation with stable and reproducible results substantially unaffected by positive ionization with currents of at least five milliamperes and with voltages of at least 200 volts.

24 30. Apparatus for controlling an electric current comprising a vacuum tube, an anode and an electron emitting cathode in the circuit of said current and within said tube, the degree of evacuation of the tube and the relation of its parts being such that for voltages materially above ionization voltage the current is governed or limited by the electric field of the electrons in said tube substantially unaffected by positive ionization, and a third electrode in said tube by which an auxiliary controlling electro-motive force may be superposed to modify the effect of said electric field and control said current in a stable and reproducible manner.

25 31. The method of controlling an electric current in one circuit by an electro-motive force in another circuit which consists in causing said current to pass as a discharge at voltages materially above ionization voltages across a vacuous space between an electron emitting cathode and an anode, maintaining a high vacuum in said space, governing or limiting the current by a space charge effect

substantially unaffected by positive ionization in said space, and superimposing the effect of said electromotive force on said space charge effect to control said current in a stable and reproducible manner, ~~substantially unaffected by positive ionization.~~

Inserted

REMARKS

The amendments to the specification preceding the claims amount to a repetition, at one page of the specification, of statements that appear explicitly elsewhere. It is thought that such repetition will serve to dispel any possible lack of clearness at the points where the amendments are introduced. In this connection, reference is made to the original specification, page 2, lines 15 and 16; page 6, line 7; page 10, line 25; and page 18, line 14; which refer to the same matter.

The new claims submitted by this amendment and numbered 20 to 29 inclusive, correspond respectively to the opposing party's claims 26 and 1 to 9 inclusive, and are made in direct response to the suggestion of the Patent Office.

The high vacuum and the space charge effect to which the foregoing claims refer are of peculiar significance in connection with a tube having a third electrode, for by virtue of the space charge effect it becomes possible definitely to influence the space current by a mere slight change of potential on the third electrode, and the absence of positive ionization insures stable and reproducible operation. One of the useful functions of a tube thus characterized is that it becomes possible to put a considerable negative potential on the third electrode without producing any considerable current in the circuit of that third electrode. Following the Law Examiner's decision, it is believed that these aspects of the pure

electron discharge tube should be stated in claims and patented. Accordingly claims 30 and 31 have been drawn along lines indicated in the decision of the Law Examiner, which decision has now become part of the "law of the case". In connection with these new claims, attention is directed to applicant's original claims 4 and 6 inter alia.

Favorable action at an early date is requested.

Respectfully submitted,

By HAROLD D. ARNOLD,

Per George E. Falk
Attorney.

Form 112

Paper No. 16

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON

U.S. PATENT OFFICE
APR 5 1921
MAILED

Mr. John C. Roberts,
463 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of
Harold D. Arnold, Ser. #59,210, filed Nov. 2, 1915.
Thermionic Devices and Method of Constructing and Operating same.

M. H. COULSTON
Secretary of Patents.

The following counts have been added to interference No. 40,380, ARNOLD vs. LANGMUIR, in accordance with the decisions of the Law Examiner dated Feb. 25, 1921 and March 18, 1921:

3. An electrical device comprising the combination of a sealed evacuated envelope, a cathode adapted to be independently heated, and an anode within said envelope, an external circuit connected to said electrodes, and a source of electromotive force applied to said circuit, the degree of vacuity and the electron emission of the cathode being so related to the potential of said source that the flow of current over a range of voltage materially above the ionization voltage is governed by the electric field of the electrons in the vacuous space and the potential applied to said electrodes, operatively independent of gas ionization.

5. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the governing or limiting action on the space current due to the electric field of said electrons is substantially unaffected by positive ionization and by secondary electron emission from the walls of the tube.

4. A discharge tube having a cathode adapted to emit electrons and an anode adapted to receive said emitted electrons, the tube walls being fashioned or shaped to permit the direct passage of a useful proportion of said electrons from cathode to anode, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the space current is governed or limited by the electric field of said electrons substantially unaffected by positive ionization.

5. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that in that range the space current is governed by the combined effect of the electric field of said electrons and the potentials applied to said electrodes, the governing or limiting of the current being substantially unaffected by positive ionization and by secondary electron emission from the walls of the tube.

6. A discharge device comprising a tube and electrodes therein one of which is adapted to emit electrons, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed upon electrodes of the device and when the electron emission has any value such that the space current is below the saturation region at such voltages, that the slope of the line obtained by plotting the logarithms of values of said current, as ordinates against the logarithms of the corresponding values of said impressed voltages as abscissae shows no increase for increasing voltage values.

7. A discharge device comprising a tube and electrodes therein one of which is adapted to emit electrons, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the device and when the electron emission has any value such that the space current is below the saturation region at such voltages, that the line obtained by plotting the logarithms of any values of said current below the saturation region as ordinates against the logarithms of the corresponding values of said impressed voltages as abscissae is straight and continuous.

8. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the tube and when the electron emission has any value such that the space current is below the saturation region at such voltages, that said current varies as the three halves power of said impressed voltages.

9. A discharge device comprising a tube and electrodes therein one of which is an electron emitting cathode, the degree of evacuation of said device and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the device and when the electron emission is such that the space current is below the saturation region at such voltages, that said current is substantially independent of the cathode temperature and unaffected by secondary electron emission from the walls of the tube.

10. A discharge tube having electrodes at least one of which is adapted to emit elbetrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the space current is governed or limited by the combined effect of the electric field of said electrons and the potentials applied to said electrodes, substantially unaffected by positive ionization, the heating effect in the tube due to said current occurring substantially only at one or more of said electrodes.

11. A discharge tube having a cathode adapted to emit electrons, an anode adapted to receive electrons and tube walls fashioned or shaped so as to permit the free passage of a useful proportion of said electrons from cathode to anode, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of operation with stable and reproducible results substantially unaffected by positive ionization, with currents of at least 5 milliamperes and with voltages of at least 200 volts.

12 Apparatus for controlling an electric current comprising a vacuum tube, an anode and an electron emitting cathode in the circuit of said current and within said tube, the degree of evacuation of the tube and the relation of its parts being such that for voltages materially above ionization voltage the current is governed or limited by the electric field of the electrons in said tube substantially unaffected by positive ionization, and a third electrode in said tube by which an auxiliary controlling electromotive force may be superposed to modify the effect of said electric field and control said current in a stable and reproducible manner.

13. The method of controlling an electric current in one circuit by an electromotive force in another circuit which consists in causing said current at voltages materially above ionization voltages to pass as a discharge across a vacuous space between an electron emitting cathode and an anode, maintaining a high vacuum in said space, governing or limiting the current by a space charge effect in said space substantially unaffected by positive ionization, and superimposing the effect of said electromotive force on said space charge effect to control said current in a stable and reproducible manner.

The preliminary statement required by Rule 110, as to the added counts only, should be filed on or before MAY 2 1921

The relation of all the counts to the claims of the parties is now as follows:

Counts:	Arnold:	Lowenstein:
1	19	14
2	20	25
3	21	1
4	22	2
5	23	3
6	24	4
7	25	5
8	26	6

Ser. #59,210 - #4.

Counts:	Arnold:	Langmuir: (Con)
9	27	7
10	28	8
11	29	9
12	30	38
13	31	39

In applicant's claim 28, line 3, the should be inserted after "permit" to agree with count 4 as declared.

H.L.M.

C. D. Baskin

Exr., Div. 16. 11/49

1169

Div. 51 Room 240-Annex

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name. HHH/tr

Paper No. 28

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON Sept. 14, 1925.

All communications regarding this application should give the serial number, date of filing, and name of the applicant.

Please find below a communication from the EXAMINER in charge of this application

Thomas E. Robertson
Commissioner of Patents

Applicant: N. D.P. Arnold

John G. Roberts,
463 West Street,
New York, N.Y.

Ser. No. 59,210
Filed Nov. 2, 1915
For Thermionic Devices and Method of Constructing and Operating the Same.

MAILED
SEP 14 1925

This application comes before the examiner on the termination of the interference in which it was involved.

Claims 27 and 30-31 stand finally rejected in view of the adverse decision in the interference.

Claims 2, 3, 11, 16, 18 and 19 stand finally rejected in view of the Law Examiner's decision in the interference.

Claims 1, 4-10 and 12-15 are rejected on the adverse decision in the interference.

In view of the long pendency of this case applicant's next amendment should place the case in condition for final adjudication.

H.H.H.

Examiner, Div. 51.

64/50

PAPER NO 19
AMENDMENT D

MAY 1925 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 51 Room 240-Annex

HAROLD D. ARNOLD :
:
Serial No. 80,210 : Invention: Thermionic Devices and
: Method of Constructing and
Filed November 2, 1916 : Operating the Same.

COMMISSIONER OF PATENTS,

Washington, D. C.

MAY 3 - 1926

Sir:

In response to the Office action dated September 14, 1925, amendment is made as follows:

Cancel claims 2, 3, 11, 16, 18 and 19.

Renumber the remaining claims as 1 to 25.

Add the following claims:

--26. The method of amplifying a variable electric current without distortion, which comprises producing a substantially pure electron discharge from a hot cathode to an anode across said cathode and anode at a voltage for which the variation of the current with the voltage is most nearly constant, and applying the input current to produce corresponding electromotive forces across said cathode and a grid, thereby varying said discharge within the range for which the ratio of current increment to voltage increment across said cathode and anode remains substantially constant.

--27. The method of amplifying a variable electric current without distortion, which comprises producing a substantially pure electron discharge from a hot cathode to an anode across said cathode and anode at a voltage corresponding to a point on the volt-ampere characteristic just below its knee, and applying the input

current to produce electromotive forces across said cathode and a grid, thereby varying said discharge within a voltage range corresponding to a part of said characteristic that exhibits no substantial departure from a straight line.

--26. The method of amplifying a variable electric current without distortion, which comprises the production of a substantially pure electron discharge from a hot cathode at a voltage for which the corresponding current shows only the beginning of the saturation effect, and applying the input current to produce electromotive forces across said cathode and a grid to vary said discharge within a comparatively narrow voltage range.--

Per E

Insert A

REMARKS.

Favorable reconsideration for this application as now presented is respectfully requested.

Applicant has cancelled the claims rejected by the Examiner on the authority of the Law Examiner's decision.

Applicant notes the rejection of the remaining claims 1 to 25 as now renumbered, and recognizes that the Examiner, at this time is necessarily governed by the decision of the Court of Appeals of the District of Columbia to which he refers. These claims are retained to preserve applicant's rights under Section 4915 of the Revised Statutes.

The new claims 26, 27 and 28 added by the present amendment are directed to advantageous utilization of a three electrode vacuum tube as an amplifier. The principle involved is to work in that part of the voltage range substantially above the voltages at which gas ionization ordinarily occurs (page 6 of specification,

line 23 and contact and below voltages approaching saturation, where the ratio between output current increments and input voltage increments is substantially constant. This is explained in the specification, page 7 line 29 et seq.

Said Claims 26, 27 and 28 could not have been made in the application with which the present application was in interference and they are believed to be directed to novel, patentable subject-matter.

Applicant hereby notifies the Patent Office that on April 29, 1926 he and his assignee filed a suit under Section 4915 of the Revised Statutes against the opposing parties in interest in the Interference hereinbefore mentioned. It is understood that under the doctrine of Sandy v. Marble, 122 U. S. 432 and other cases, the prosecution of said suit will be regarded as a continuation of prosecution of the present application, and that the Patent Office will hold the present application not subject to abandonment by operation of the statute and rules of practice while the said suit is being prosecuted.

Subject to the conditions stated in the foregoing remarks, favorable action at an early date is requested.

Respectfully submitted,

By HAROLD D. ARNOLD,

Per _____ Attorney.

New York, April 30, 1926.

1173

No. 51 240-INVENTION Paper No. 20

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON May 20, 1926.

ERC/hz

Please find below a communication from the EXAMINER in charge of this application

James E. Ellerton
Commissioner of Patents

Applicant: H. De F. Arnold

John G. Roberts,
463 West Street,
New York, N.Y.

Ser. No. 129110
Filed Dec. 1, 1925
For SYSTEMS FOR AND METHODS OF CONTROLLING AND OPERATING THE SAME.

MAY 20 19

Responsive to amendment filed May 1, 1926.

Claims 26, 27 and 28 are rejected as improper ~~METHOD~~ claims since they pertain apparatus limitations. These claims are not expressed independently of the specific structure of the articles employed or independently of the structure of the apparatus through which the process is carried out.

Claims 25 to 28 are further rejected as indefinite in that they fail to clearly indicate whether the voltage excited is to be interpreted as the filament or plate source of energy.

awc

Examiner.

Div. 51 Room 240-Annex Paper No. 22

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

AWC/tr WASHINGTON June 7, 1926.

Please find below a communication from the EXAMINER in charge of this application

Thomas E. Robertson
Assistant Commissioner of Patents

Applicant: H. De F. Arnold

Ser. No. 59210
Filed Nov. 2, 1925
For THERMIONIC DEVICES AND METHOD OF CONSTRUCTING AND OPERATING THE SAME.

John G. Roberts,
463 West Street,
New York, N.Y.

JUN 7 1926

Responsive to letter filed June 1, 1926.

A certified copy of the Bill of Complaint has been entered in this case. Applicant is advised however, that this does not alter the status of the case as regards the rejection of claims 1-25 or the rejection of claims 26 to 28.

Applicant may retain claims 1 to 25 in the case to preserve his rights under Section 4915 of the Revised Statutes.

A response to the rejection of claims 26 to 28 must be filed on or before May 20, 1927.

awc

Examiner.

1175

PAPER No 23
AMENDMENT E

MAIL ROOM MAY 6 1927 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE

Division 51 Room 240-Annex

E

Harold D. Arnold :

Serial No. 59,210 : Invention: Thermionic Devices and Method of Constructing and Operating the Same.

Filed November 2, 1915:

PATENT OFFICE MAY 6 - 1927 DIV. OF PAPERS

COMMISSIONER OF PATENTS,

Washington, D. C.

Sir:

In response to the Office Letters dated May 20, 1926 and June 7, 1926, amendment is made as follows:

Claim 26, line 3, after "cathode" insert --to an anode--; same claim, line 4, after "voltage" insert --across said cathode and anode--; same claim, last line, after "increment" insert --across said cathode and anode--.

Claim 27, line 3, after "cathode" insert --to an anode--; same claim, line 4, after "voltage" insert --across said cathode and anode--.

Claim 28, line 4, after "cathode" insert --to an anode--; same line, after "voltage" insert --across said cathode and anode--.

REMARKS

Favorable reconsideration for this application as now presented is respectfully requested.

Applicant notes the statement by the Office that a certified copy of the Bill of Complaint in this case under R. S. Section 4915 has been entered and made of record. The case referred to has not yet come to

trial; whenever there is any significant development in it, the applicant will notify the Patent Office.

In regard to the rejection of claim 24 it [illegible] this is understood to be based on two grounds.

One of these grounds is that these claims are "improper" method claims since they contain apparatus limitations". Most patentable methods can be performed only with the aid of apparatus elements, and most such methods can be claimed only with mention of the apparatus elements involved. Even if a studied wording is employed that evades the mention of the apparatus elements, nevertheless they are implied and understood, and since the Patent Office will look to substance rather than form, it will not discriminate against method claims merely because they make explicit mention of apparatus elements that are implied and understood whether they are mentioned or not.

The most undoubted method claims, such as those relating to chemical methods, necessarily involve apparatus elements, whether expressed or not. If a solution is to be filtered, a filter is involved; if a precipitate is to be roasted, a burner or an oven or something of the sort is involved; etc. The foregoing argument is not altered by the fact that in comparatively rare exceptional cases there are patentable methods that are performed without apparatus, as, for example, some methods of weaving by the unaided fingers.

Consider claim 24. The first apparatus element mentioned is the "hot cathode". In form this could be avoided by applying the adjective "thermionic" to the noun "discharge" in the same line of the claim. But this would be a mere change of form, for a thermionic

discharge necessarily implies a hot cathode. It is believed that the Office will not insist on such changes of form which do not really affect the substance.

Again, in the same claim, mention is made in line 7 of "a grid". Perhaps this could be avoided by calling for the production of an electric field upon and about said cathode. But everyone knows that such a superposed electric field could only be produced by the aid of an electrode between which and the cathode the lines of electric force would extend. Applicant respectfully submits that it would be better bluntly to say "a grid" instead of adopting a circumlocution that implies the same thing but avoids expressly saying it.

To summarize on this phase of the case, it is respectfully submitted that claim 26, and likewise claims 27 and 28, are true method claims. They do not present a necessary function of the apparatus elements mentioned therein. Those elements could be used in diverse ways, and the use of them presented in these claims is a true patentable method.

In the interference in which this application has been involved method claims have been allowed which mention apparatus elements. For example, consider claim 22 of the Langmuir patent 1,558,436. This claim has been regarded as a true method claim although it mentions "a discharge *** between an electron emitting cathode and an anode".

In regard to the second ground of rejection against the claims, namely, "that they fail to clearly indicate whether the voltage recited is to be interpreted as the filament or plate source of energy", this

has been met by what is believed to be an appropriate amendment in each claim. Stated briefly and informally, the method of these claims involves, first, setting up a pure electron thermionic discharge with a locally adjusted voltage across the hot cathode and the corresponding anode; then, having secured the right adjustment of this voltage, as pointed out in the claims, the electromotive forces corresponding to the currents to be amplified are superposed in their effect on the cathode, and thereby amplified variations in the main discharge current are produced. It is believed that the amendments make this entirely clear.

Favorable action at an early date is requested.

Respectfully submitted,

HAROLD D. ARNOLD,

By J. B. Robuts
Attorney.

MAY - 4 1927

1179

Div. 51 Room 240 ANNEX ANX:H Paper No. 24

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON May 18, 1927.

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

John G. Roberts,
463 West St.,
New York City, N. Y.

Applicant: R. De Forest Arnold
Ser. No. 59,210
Filed Nov. 2, 1915
For Thermionic Devices and Method of Constructing and Operating the Same.

MAILED
MAY 18 1927

In response to amendment of May 5, 1927.

Claims 26 to 28 are again rejected as improper method claims for reasons stated in the Office Action of May 20, 1926.

If applicant is of the opinion that these claims can be amended to avoid the objections of record by merely changing their form, he is advised to take such an action.

In view of the proceedings under Section 4915 R. S. no further action on claims 1 to 25 is taken at this time.

D.W.C.

L. D. Becker
Examiner.

THIS ACTION MUST BE RESPONDED TO WITHIN SIX MONTHS.

PAPER NO. 25
AMENDMENT

MAIL ROOM NOV 15 1927 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 51 Room 240-Annex

Harold D. Arnold :
Serial No. 59,810 : Invention: Thermionic Devices and Method of Constructing and Operating the Same.
Filed November 2, 1925 :

PATENT OFFICE NOV 16 1927 DIV. 51 FILED

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action dated May 18, 1927, amendment is made as follows:

Add the following claims:

--29. The method of amplifying a variable electric current without distortion which comprises producing a substantially pure electron discharge current at a corresponding adjusted voltage for which the variation of the current with the voltage is most nearly constant, and applying the said variable electric current to produce corresponding superposed electro-motive forces in the path of said discharge current, and thereby varying said discharge current accordingly within the range for which the ratio of current increment to voltage increment for said discharge current remains substantially constant.

--30. The method of amplifying a variable electric current without distortion which comprises producing a substantially pure electron discharge current at a corresponding adjusted voltage on the current-voltage characteristic just

below its knee, and applying the said variable electric current to produce corresponding superposed electro-motive forces in the path of said discharge current, and thereby varying said discharge current accordingly within a range corresponding to a part of said characteristic that manifests no substantial departure from a straight line.

--31. The method of amplifying a variable electric current without distortion which comprises the production of a substantially pure electron discharge current at a corresponding adjusted voltage for which the said discharge current shows only the beginning of the saturation effect, and applying the said variable electric current to produce electro-motive forces in the path of said discharge current to vary it within a comparatively narrow voltage range.

--32. The method of amplifying a variable electric current without distortion which comprises producing a substantially pure electron discharge current limited by a space charge effect and at a corresponding adjusted voltage for which the variation of the current with the voltage is most nearly constant, and applying the said variable electric current to produce corresponding electro-motive forces superposed on said space charge effect, and thereby varying said discharge current accordingly within the range for which the ratio of current increment to corresponding voltage increment for said discharge current remains substantially constant.

REMARKS.

Favorable consideration for this application as now presented is respectfully requested.

As to the rejection of Claims 26 to 28, this is understood to be on the ground that "they contain apparatus limitations", quoting from the Examiner's letter of May 20, 1926. For the reasons stated in the letter filed May 5, 1927, it is respectfully urged that there is not enough mention of apparatus in these claims to warrant their rejection.

Of the new claims now presented by amendment, those numbered 29, 30 and 31 have been patterned respectively after Claims 26, 27 and 28 but with care to avoid explicit mention of elements of apparatus. Whether or not the Examiner's criticism of Claims 26, 27 and 28 is just, it is respectfully submitted that new claims avoid such criticism and should be allowed accordingly.

The new claim added by this amendment, numbered 32, is somewhat along the line of Claims 26 and 29 but differs from them in its mention of the space charge effect. In that aspect of the invention which is involved in Claim 32, the electron discharge is at such a corresponding voltage adjustment that it is limited in value by the space charge effect; and on this is superposed the effect of the variable current which is to be amplified.

In regard to the "proceedings under Section 4915 R.S.", which have been mentioned heretofore, the case in the Southern District of New York is on the calendar awaiting call for trial.

Favorable action at an early date is requested.

Respectfully submitted,

HAROLD D. ARNOLD,

By _____
Attorney.

NOV 14 1927

Div. 51 Room 240-Annex

Address only "The Commissioner of Patents, Washington, D. C." and not any individual by name

AWC/tr

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON July 2, 1928.

Paper No. 26

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

John G. Roberts,
463 West Street,
New York, N.Y.

Applicant: H. De Forest Arnold

Ser. No. 59210
Filed Nov. 2, 1916
For THERMIONIC DEVICES AND METHODS OF CONSTRUCTING AND OPERATING THE SAME.

JUL 2 1928

Responsive to amendment filed Nov. 15, 1927.

It appears from the testimony presented in General Electric Co., vs. DeForest Radio Co., decided in the District Court of the United States for the district of Delaware by Judge Hugh M. Morris, that a prima facie case of public use exists against this applicant. This conclusion is based on the further fact that the amplifying characteristic of three electrode tube was already known. Public use of an amplifier by De Forest in 1912 was apparently accompanied by no great degree of secrecy; claims 26-32 are accordingly rejected.

In view of the proceedings under Section 4915 R.S. no further action on claims 1-25 is taken at this time.

awc

Examiner.

44/64

#27 1184
Argument

MAIL DIVISION
DEC 20 28
U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE

Division 51. Room 260-Annex.

Harold D. Arnold :
Serial No. 89,210 : Invention: Thermionic Devices and Method of Constructing and Operating the Same.
Filed Nov. 8, 1915 :

PATENT OFFICE
DEC 21 1928
DIVISION

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action dated July 2, 1928, the Patent Office is respectfully asked to reconsider its rejection of Claims 26 to 32.

These claims have been rejected on what the applicant understands to be an alleged prima facie showing of public use. In reply, it will be pointed out (1) that the data to which the Examiner refers do not make a prima facie showing of public use; (2) that the alleged showing of public use on which the Examiner relies is vague and indefinite and should be specified more particularly, and (3) that the rejection is premature and a different procedure should be followed if the Office is to persist in the attitude indicated in the last Office action.

(1) Applicant's attorney is somewhat familiar with the testimony in the case to which the Examiner refers, namely General Electric Company v. DeForest Radio Company, No. 309 in the United States District Court for the District of Delaware. The attorney finds nothing in this testimony to anticipate the

LL/GS

claims here under discussion. These are not broad claims for amplifying, but are specific claims for amplifying in a particular way. These claims relate to amplifying with such a voltage adjustment that the current increments are proportional to the voltage increments over the range of current and voltage that is involved. This adjustment is not a necessity for amplifying but is an advantage. It may be that the testimony on which the Examiner relies contains disclosure of the practice of amplification more than two years before the present application was filed; but there is nothing in the testimony to show that any such amplification was practiced at the advantageous voltage adjustment which is expressly indicated in the claims.

(2) The record in the Delaware case on which the Examiner relies contains nearly 2000 pages of testimony in addition to several thousand pages of exhibit material. It is respectfully submitted that the Examiner should have made his reference to this testimony more particular. It is now requested that the Examiner take up at least one representative claim among the rejected claims and give particular page reference to the testimony on which he relies to show the steps recited in such claim. Especially it is asked that he point out the testimony on which he relies for the step of optimum adjustment of the voltage. It is believed that when a particular claim is considered step by step, in relation to particular pages or questions and answers of the printed record, it will become apparent that the testimony contains no disclosure of applicant's method in public use more than two years before his filing date.

(3) Attention is directed to the digest of the law relating to public use and public use proceedings, found on pages 12 to 20 of the book on "Patent Office Practice" by A. R. McCready, published in 1928 by the H. D. Williams Company, Ouray Building, Washington, D. C. If the Examiner believes that the testimony in the Delaware case makes a prima facie showing of public use, nevertheless it is premature to reject the claims. The proper procedure would be as stated at the bottom of page 14 and top of page 15 of the book referred to, namely to advise the Commissioner of the situation, whereupon, if the Commissioner adopts the Examiner's view, he will take steps to institute the usual "public use proceedings." See the cases cited in connection with the foregoing reference, and also see the bottom of page 252 and top of page 253 of "Underwood's Interference Practice" published in 1928 by Patent Law Publishing Company, Detroit, and the cases cited in connection with this reference.

Public use, as a basis for rejection, can only be established by testimony taken on notice to applicant and with opportunity to applicant to cross-examine witnesses and to produce testimony in reply. Hitherto, applicant has had no such opportunity to confront the witnesses and to cross-examine, still less to produce testimony in reply.

In regard to the "proceedings under Section 4915 R. S." mentioned in the Office letter, the case referred to in the Southern District of New York is still on the docket and has not yet been brought to trial.

The Delaware case to which the Examiner refers as having been decided by Judge Hugh M. Morris, is now pending

on appeal in the Circuit Court of Appeals for the Third Circuit. It is understood that it is expected to be argued in March or April, 1929.

For the reasons set forth above, it is respectfully submitted that Claims 26 to 32 are not properly rejected on the alleged public use to which the Examiner refers, and that these claims should be pronounced allowable.

Respectfully submitted,

HAROLD B. ARNOLD,

By _____
Attorney.

Div. 51 Room 240-Annex

Address only The Commissioner of Patents, Washington, D. C., and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON September 20, 1929.

Paper No. 28

RECEIVED SEP 20 1929

AMO:MHG

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

John G. Roberts,
463 West Street,
New York, N. Y.

Applicant: H. DeF. Arnold

Ser. No. 59,210
Filed Nov. 2, 1915
For Thermionic Devices and Method of Constructing and Operating the Same.

Responsive to applicant's communication of December 20, 1928.

The rejection of claims 26-32 on the ground set forth in the Office action of July 2, 1928 is withdrawn in view of the lack of sufficient evidence proving public use of a high vacuum thermionic discharge device by De Forest to form an anticipation for the subject matter recited in the above claims.

Claims 24-32 are now rejected as failing to define invention over the issue of the interference in which this application has been involved. (See claim 25 formerly claim 31).

In view of the proceedings under Section 4915 R.S. no further action on claims 1-25 is taken at this time.

Drawings

#29
Argument

MAIL DIVISION
MAR 17 1930
U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE

Division 51 Room 240 Annex

Harold D. Arnold :
Serial No. 59,210 : Invention: Thermionic Devices and Method of Constructing and Operating the Same.
Filed November 2, 1915 :

PATENT OFFICE
MAR 17 1930

COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

In response to the Office Action dated September 20, 1929, the Patent Office is respectfully requested to reconsider its rejection of Claims 26 to 32.

These claims have been rejected "as failing to define invention over the issue of the interference ....". As an example of the counts of that issue, the Examiner goes on to mention Claim 25, formerly 31.

All of the Claims 26 to 32 relate to the idea of establishing such a relation among the elements of the combination that amplification shall occur at the straightest part of the characteristic volt-ampere curve. This is a patentable improvement over the interference issue. Considering, for example, Claim 25 to which the Examiner has made reference, - according to this claim, operation might be anywhere along the characteristic curve, provided merely that it was "materially above ionization voltages". For example, so far as the interference issue is concerned, operation might be well up on the "knee" of the characteristic curve. This might give considerable distortion, but nevertheless it would answer to Claim 25; it would give "control

[of] said current in a stable and reproducible manner".

Now applicant comes along with a patentable improvement by which the distortion that would occur in such a case is avoided. This improvement is explicitly defined in the claims under rejection, and is not hinted at in any one of the claims of the interference issue. The improvement referred to lies in establishing such a relation that the operation of the tube as an amplifier is at the straightest part of the characteristic curve.

Accordingly, it is respectfully submitted that the said rejected Claims 26 to 32 should be allowed, and favorable action at an early date is requested.

In regard to the proceeding under §4915 R.S. in the Southern District of New York, the case referred to is still on the docket and has not yet been brought to trial. If the outcome of this case should be favorable to the present applicant, it will obviously remove the ground of rejection on which the Examiner relies in the last Office Action. But applicant's contention is that he is entitled to Claims 26 to 32 whichever way the case is decided in the Southern District of New York.

In regard to the case pending in Delaware which was mentioned by the Examiner in Paper No. 26, dated 7/2/28, the appeal on this case was argued in Philadelphia early in the year 1929. Thereafter decision was given by the U. S. Circuit Court of Appeals for the Third Circuit, in favor of the defendant. Plaintiff petitioned for a rehearing, and on December 2, 1929, the Court granted its petition and the case is set for argument on or about April 1st, 1930.

Respectfully submitted,

HAROLD D. ARNOLD,

By _____
Attorney

MAR 14 1930

1196

Div. 51 Room 240-Annex DEPARTMENT OF COMMERCE Paper No. 22

Address only "The Commissioner of Patents, Washington, D.C." and not any official by name

UNITED STATES PATENT OFFICE

AWT:MDG WASHINGTON December 8, 1930.

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

MAILED DEC 8 1930

Applicant: H. D. Arnold

John G. Roberts,
463 West Street,
New York, N. Y.

Ser. No. 59,210
Filed Nov. 8, 1915
For Thermionic Devices and Method of Constructing and Operating the Same

Responsive to applicant's communication of March 15, 1930.

The general purport of applicant's argument, above-mentioned, is noted. It is not thought, however, that anything can be gained by taking further action on the merits of claims 26-28 until such time as the proceedings under Section 4915 R.S. involving claims 1-25 are terminated.

Following the practice in Ex Parte McCulloch 113 O. G. 2508 further action by the Office is accordingly suspended on claims 26-28 as well as claims 1-25.

If applicant, however, insists upon further action by the Office in the course, it will be given, but in any case, it is expected that applicant will keep the examiner informed as to the developments in the above-mentioned proceedings and notify the Office immediately upon the termination of said proceedings.

A. O. Rasmussen
Examiner

uwe.

5-9-101

1192

PAPER NO. 33
LETTER

MAIL DIVISION
NOV 18 31
U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE

Division 51 Room 240-Annex

H. D. Arnold :
Serial No. 59,210 : Invention: Thermionic Devices and Method of Constructing and Operating the Same
Filed Nov. 2, 1915 :

PATENT OFFICE
NOV 19 1931
DIV. 51 FILED

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action dated December 8, 1930, and supplementing the last two paragraphs of applicant's communication filed March 15, 1930, the following information is submitted:

As to the case pending in United States District Court in Delaware, and mentioned by the Examiner in Paper No. 26, dated July 8, 1933; after decision on appeal affirming the Delaware Court in favor of defendant, the case was re-heard by the Court of Appeals of the Third Circuit and decided in favor of plaintiff. Then on a writ of certiorari it was carried to the United States Supreme Court, which reversed the Court of Appeals, deciding in favor of defendant. The opinion was published in 403 O. G. 835. On October 19, 1931, the Supreme Court denied a petition for re-hearing and amended its opinion in connection with its earlier decision.

On November 10, 1931, the bill in the case under R. S. Section 4915 in the Southern District of New York was dismissed without prejudice, in accordance with a stipulation

between the parties.

This letter is written especially to meet the last part of the last paragraph of the Office letter of December 6, 1930 "it is expected that applicant will kedy the Examiner informed.....".

Respectfully submitted,

H. D. ARNOLD

By [signature] Attorney

NOV 17 1934

Div. 51 Form 5626 Paper No. 34

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON March 31, 1932.

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

AWC:MCG

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

MAILED
MAR 31 1932

John C. Roberts,
463 West Street,
New York, N. Y.

Applicant: Theo. Arnold
Ser. No. 39,[illegible]
Filed Nov. 2, 1925
For Thermionic Devices and Method of Constructing and Operating the Same.

Responsive to letter of November 18, 1931.

Pursuant to the information furnished by applicant in the above-mentioned letter in regard to the termination by dismissal of the proceeding under R.S., Sec. 4915 in the United States District Court for the Southern District of New York, the following ex parte action is taken in this case:

Claims 1-25 corresponding respectively to claims 1, 4-10, 13-15, 17 and 20-21 referred to in the Office action of September 14, 1929, stand rejected for reasons stated in that action.

Claims 26-32 are again rejected for reasons stated in the Office action of September 20, 1929.

This action is made final.

Clerk

L. P. McCann
Act Examiner

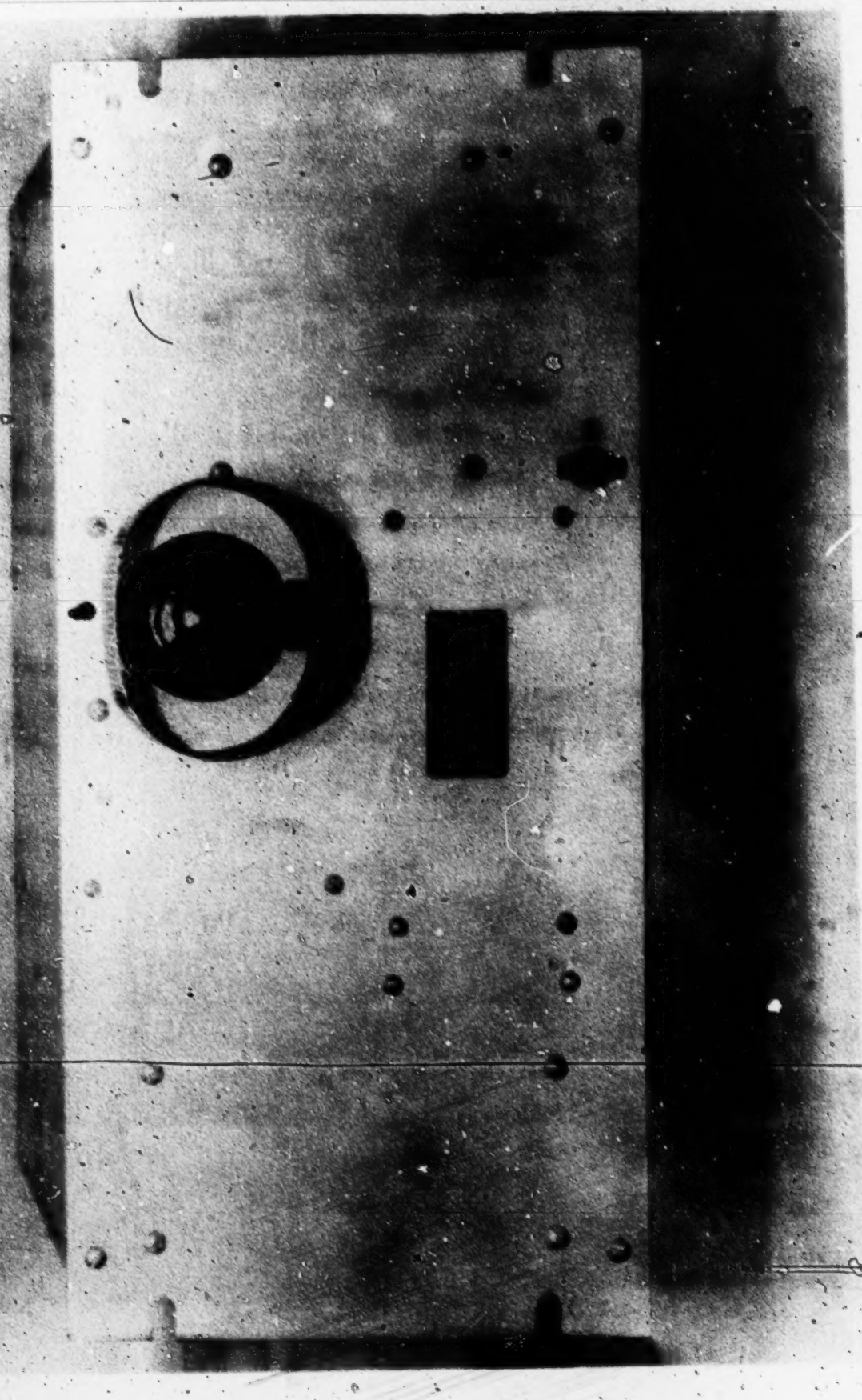
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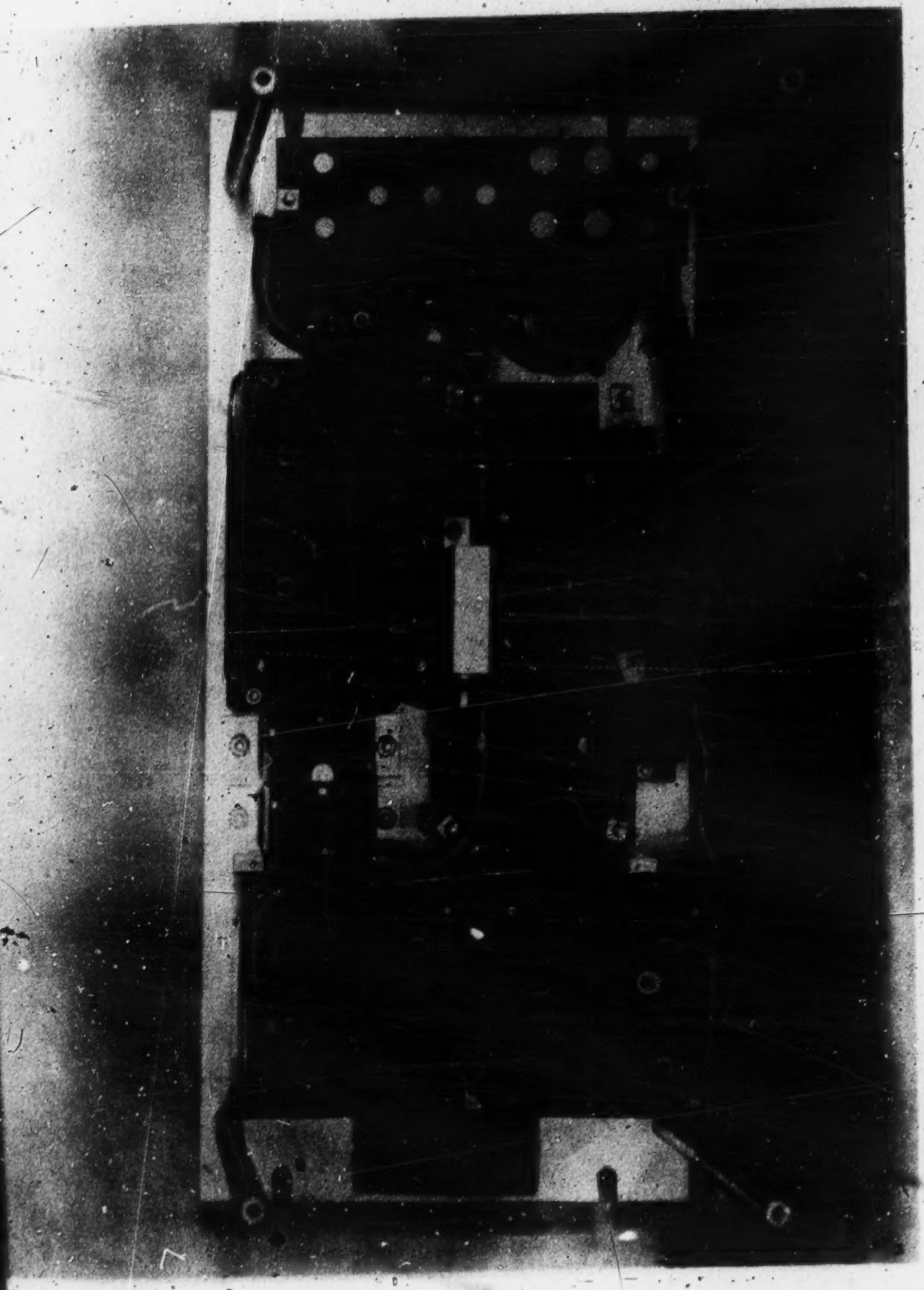
PLAINTIFF S' EXHIBIT No. 73

Group of ten photographs of the defendant's amplifiers



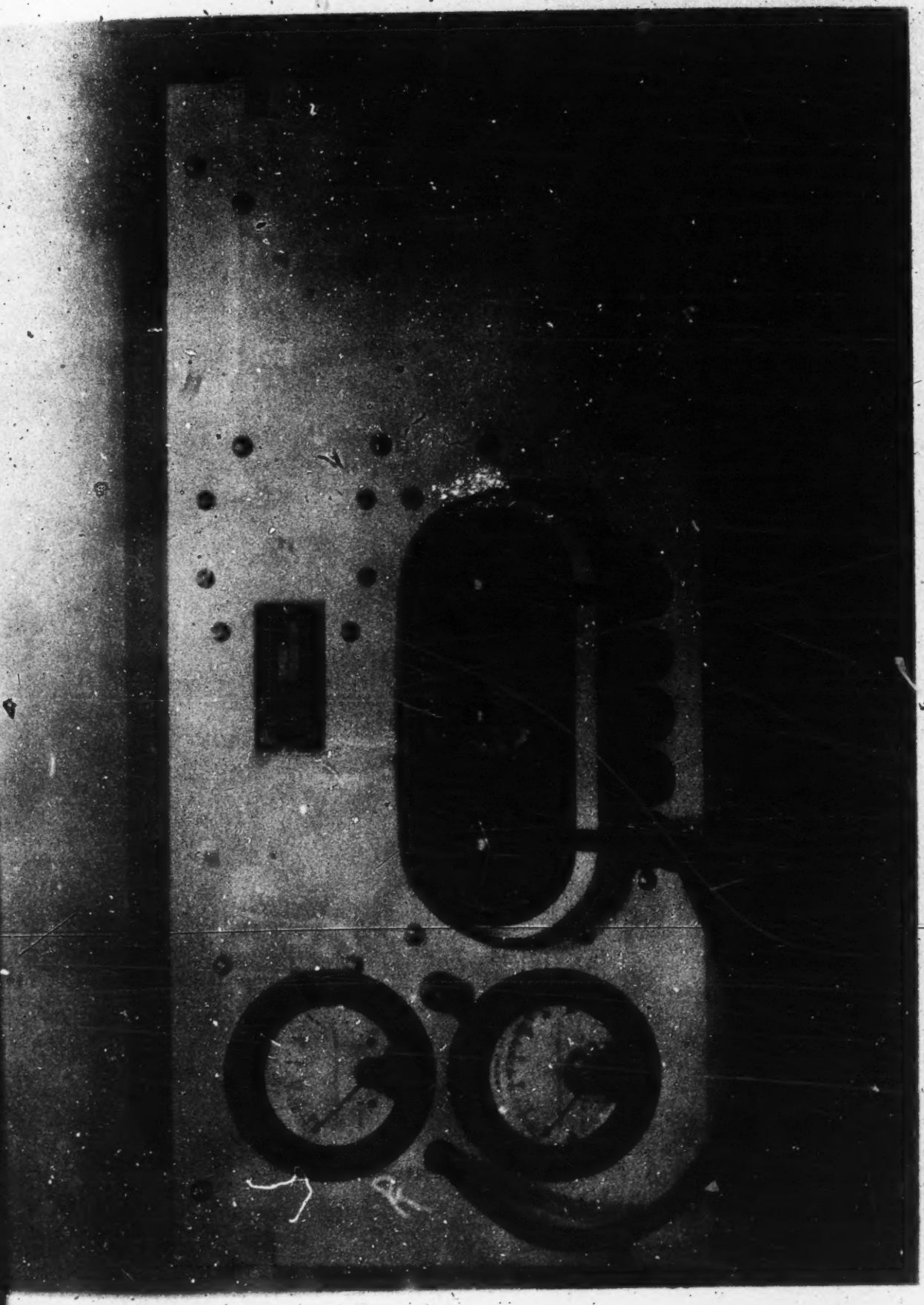
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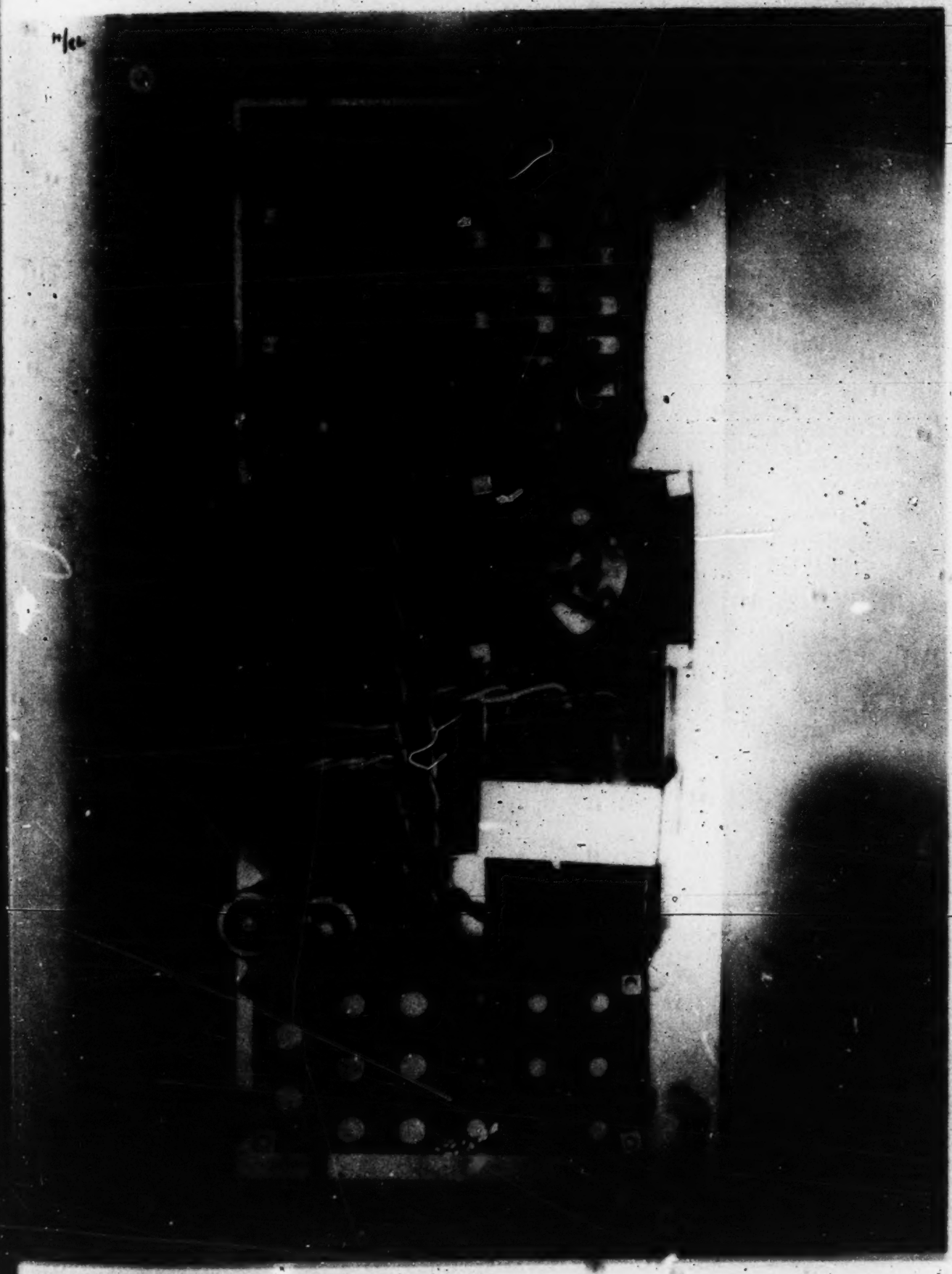
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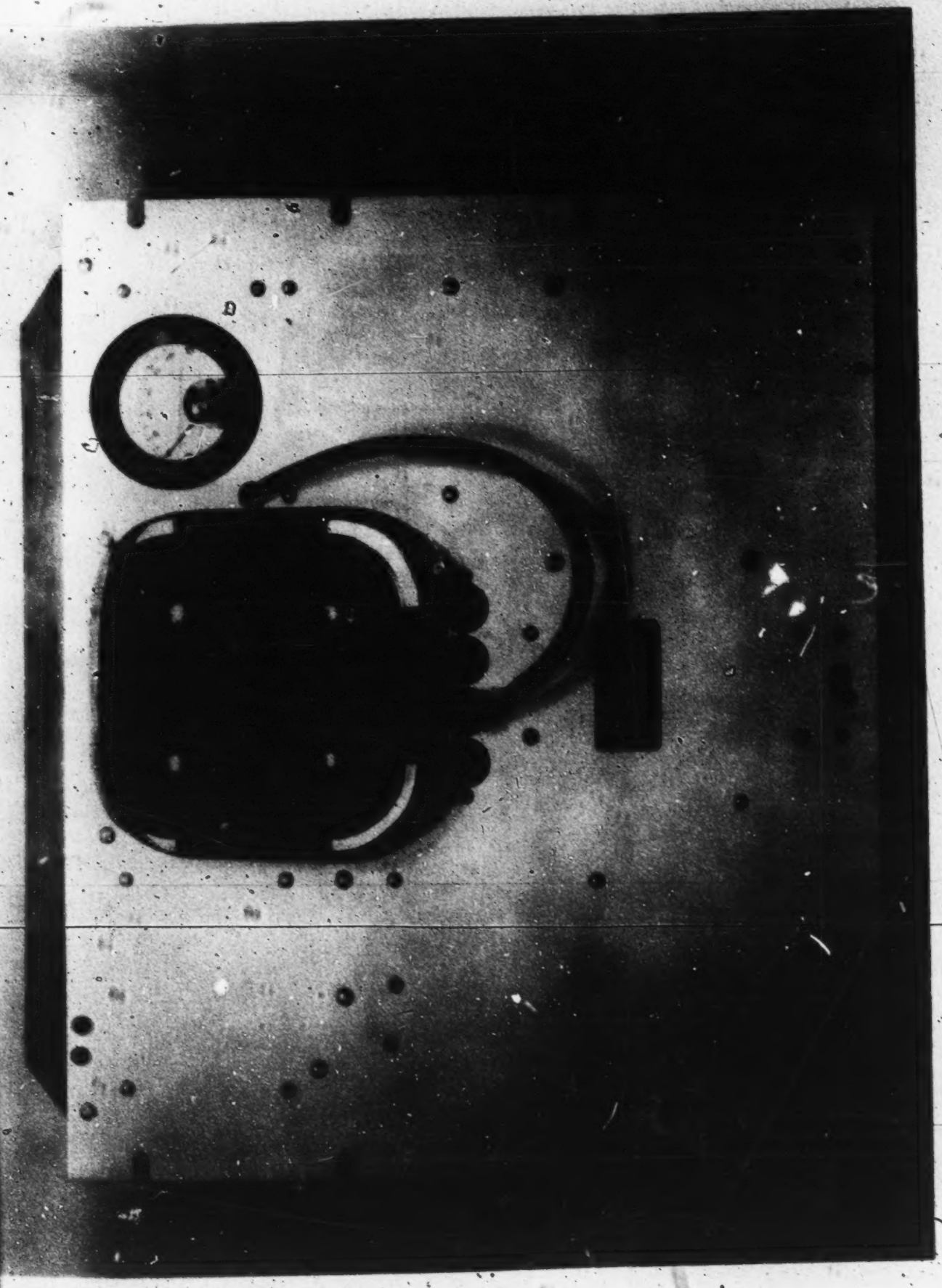
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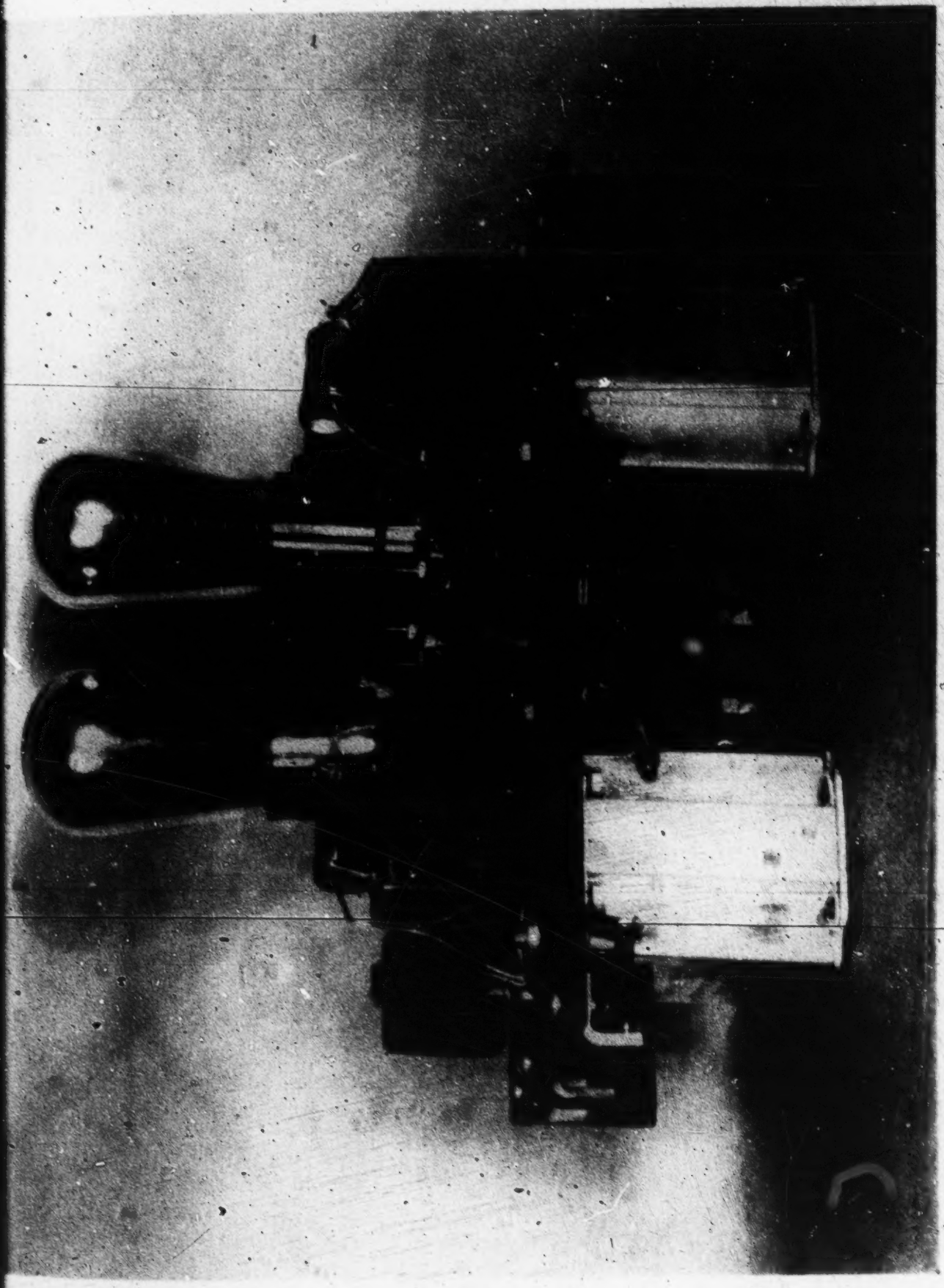
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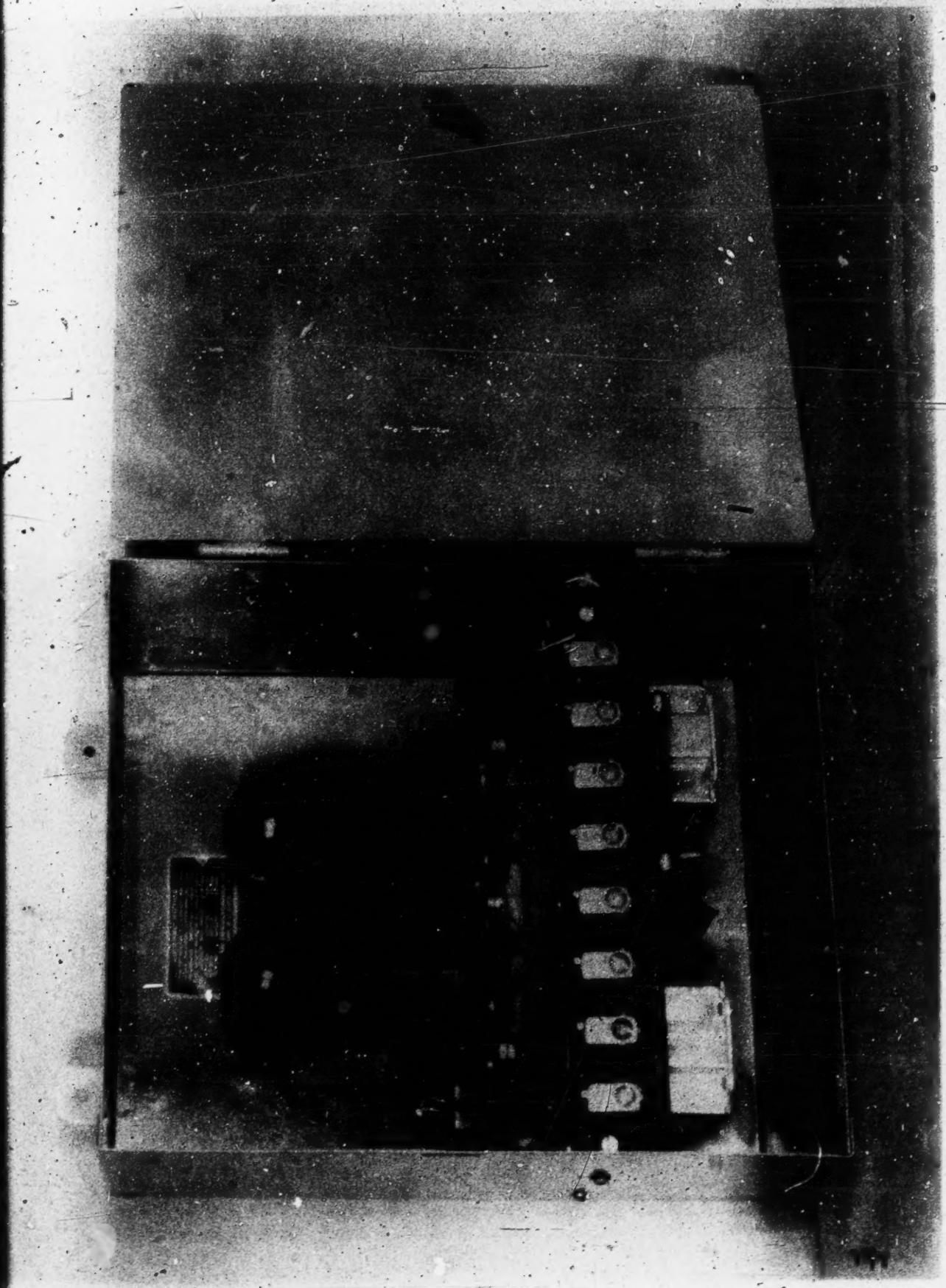
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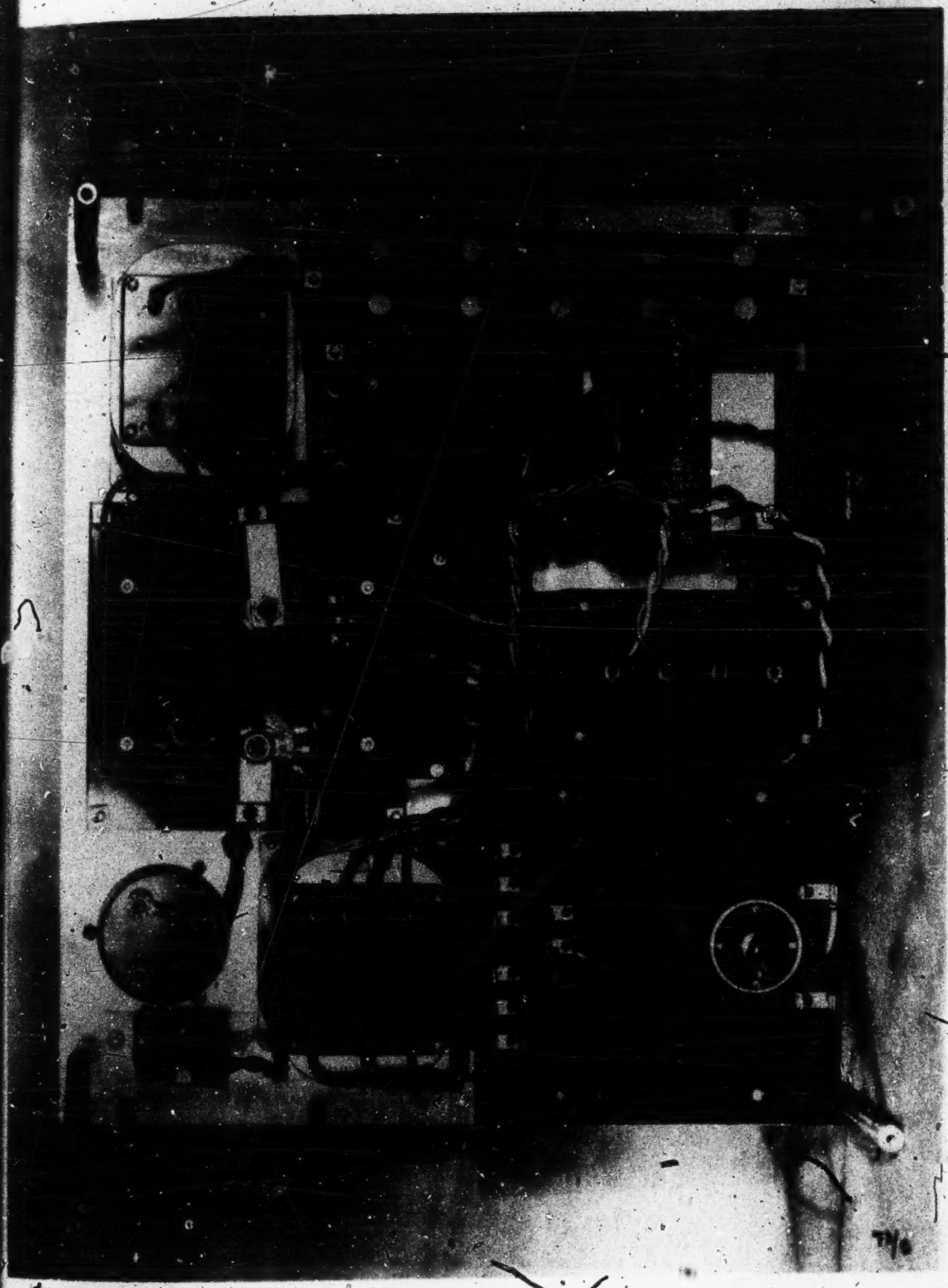
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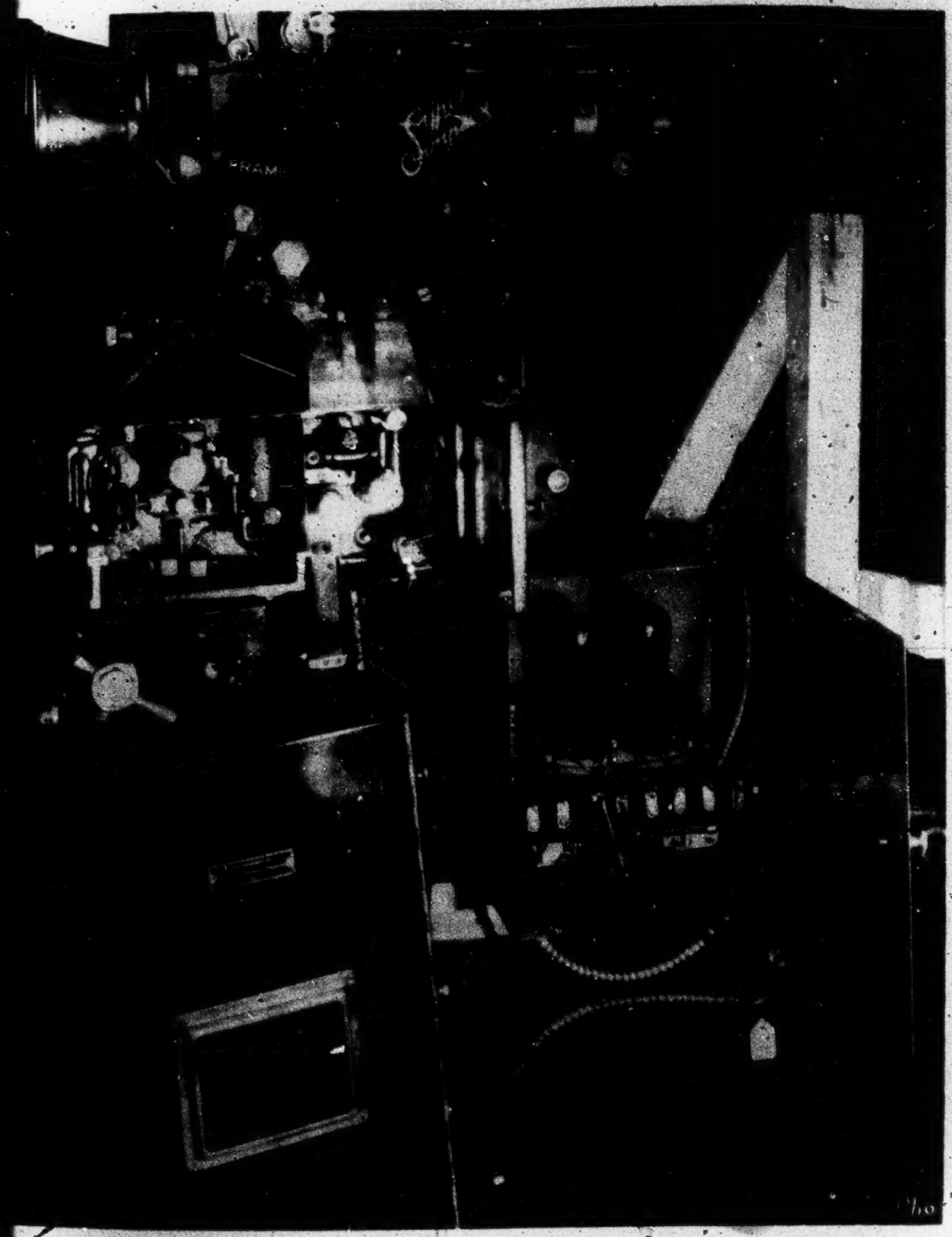


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Plaintiffs' Exhibit No. 74.

DEFENDANT'S EXHIBIT No. 66-F.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Bell System

195 Broadway
New York, November 6, 1926.

MR. EDGAR S. BLOOM, President
Western Electric Company, Incorporated,
195 Broadway, New York, N. Y. 3614

DEAR MR. BLOOM:

The American Telephone and Telegraph Company extends to the Western Electric Company, Incorporated, the privilege of manufacturing for sale or lease in the United States, systems and apparatus for recording and reproducing sound in coordination, synchronism or timed relation with the taking and projection of pictures and of entering into contracts with properly accredited individuals or organizations for the use 3615
by them of such systems and apparatus in the United States. This release is subject to restrictions as follows:

1. That the Western Electric Company, Incorporated, pay to the American Telephone and Telegraph Company a 5% royalty on its sale price. The same royalty shall also apply on all parts for repair or reconstruction where such parts are in the classification of restricted apparatus but shall not apply on other parts which

3616 *Plaintiffs' Exhibit No. 74.*

are classed as standard unrestricted apparatus.

2. That the Western Electric Company, Incorporated, furnish this equipment to the Associated Bell Telephone Companies at prices which shall be as low as the Electric Company's prices, under comparable conditions, to its most favored customers, in effect on the date of shipment.

3617

3. That the Western Electric Company, Incorporated, pay to the American Telephone and Telegraph Company 33⅓ per cent. of the gross royalties and/or other payments received by the Western Electric Company for the use of these systems and apparatus in the United States.

4. That the manufacture, sale, lease and use of these systems and apparatus shall not be other than in accordance with the conditions of the License Agreement of July 1, 1920 between the General Electrical Company and the American Telephone and Telegraph Company as Modified by the Agreement dated July 1, 1926.

3618

5. That the Western Electric Company, Incorporated, shall extend no rights covering the use of such systems and apparatus in connection with a wire distributing system except for apparatus for distribution to an assembled audience or to rooms (other than "homes") within a building or a group of substantially adjacent build-

ings commonly owned or operated, in each case located in the immediate vicinity of such audience or within the building or group of buildings within which such distribution is made:

6. That the American Telephone and Telegraph Company shall approve the form of contract to be entered into between the Western Electric Company and its customers or lessees which shall provide in 3620 particular—

(a) That said apparatus shall not be used for any other purpose than the recording and reproducing of sound in coordination, synchronism or timed relation with the taking and projection of pictures.

(b) That such licenses under patents of the American Telephone and Telegraph Company and of the Western Electric Company, Incorporated, as are extended by the latter shall be non-exclusive to at least the extent that non-exclusive rights 3621 under any and all such patents shall be reserved by the American Telephone and Telegraph Company and its Associated Companies.

The American Telephone and Telegraph Company also now withdraws the release to the Western Electric Company, Incorporated, covered by Mr. Gifford's letter to Mr. DuBois dated July 6, 1925.

Sincerely yours,

(Sgd.) W. S. GIFFORD

President.

3622 *Plaintiffs' Exhibit No. 75.*

Copies to:

E. S. Bloom
H. A. Halligan
F. B. Jewett
J. L. Kilpatrick
E. B. Craft (2)
J. W. Bancker (5)
F. B. Gleason
C. I. DeWitt (3)
3623 D. C. Tanner
R. H. Greogory
G. C. Pratt
E. P. L. Pelly
C. J. McCarthy
L. D. Gruman (2)

Plaintiffs' Exhibit No. 75.

LICENSE

3624

WHEREAS, the undersigned American Telephone and Telegraph Company, a New York corporation, is the owner of certain United States patents, and rights to and under patents, relating or applicable to systems and apparatus for recording sound and to systems and apparatus for the reproduction of sound from records thereof, including the patents listed in the schedule hereto attached and marked Schedule A; and

WHEREAS, Western Electric Company, Incorporated, a New York corporation, and Electrical Research Products, Inc., a Delaware corpora-

tion, are now engaged in making, selling, leasing, installing and using apparatus for recording sound and apparatus for reproducing sound from records thereof, by virtue of licenses from said American Telephone and Telegraph Company under said patents for certain uses or fields of business and desire to continue such business and to exclude infringers of the said patents from said field of business.

Now, Therefore, in consideration of One Dollar 3626
and other good and valuable consideration, receipt of which is hereby acknowledged, and of the royalties heretofore paid and agreed to be paid under the aforesaid licenses, the American Telephone and Telegraph Company hereby confirms the aforesaid licenses to Western Electric Company, Incorporated, and Electrical Research Products Inc. and does hereby assign and set over to said Western Electric Company, Incorporated, and Electrical Research Products Inc. all the rights which it now has or may hereafter have under or arising from said patents or any 3627
of them (specifically including without excluding others each and all of the patents listed in said Schedule A) to exclude others from the manufacture, sale, lease, installation and/or use of apparatus, devices, systems or methods

(1) for the recording of sound for the production of sound records:

(a) for sale to the public as phonograph records, or

(b) for use in connection with the exhibition of pictures, except in the home;

3628 *Plaintiffs' Exhibit No. 75.*

(2) for the reproduction of sound from sound records:

(a) as a public performance, or
(b) in connection with the exhibition of pictures, except in the home;

and for the same consideration the American Telephone and Telegraph Company assigns and sets over to said Western Electric Company, In-
3629 corporated, and said Electrical Research Products, Inc. all claims recoverable in law or in equity, whether for damages, profits, savings, or of any other kind or description which the American Telephone and Telegraph Company now has or may hereafter have arising out of the infringement of the aforesaid patents within said field; the intention being that in so far as concerns the exclusion of infringers of said patents from the aforesaid field of business, Western Electric Company, Incorporated, and Electrical Research Products Inc. shall be vested with
3630 as full rights in the premises as American Telephone and Telegraph Company would have had had this assignment not been made, including the right for their own benefit, to bring suit on said patents or any of them, either at law or in equity, against infringers in said field of business to exclude such infringers from practicing the inventions of said patents, and for their own use and benefit to collect damages which may arise by reason of the future infringement of said patents by infringers within said field of business, but nothing herein contained shall in any way affect or alter the rights of American Telephone and Telegraph Company

Plaintiffs' Exhibit No. 75. 3631

against others than infringers within the aforesaid field.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

By (Sgd.) WALTER S. GIFFORD
President

New York, N. Y.,
May 7, 1929.

SCHEDULE "A"

3632

Inventor	*Patent No.*	*Date of Issue*	*Subject-Matter*
E. H. Colpitts	1,128,292	Feb. 16, 1915	Electric-Wave Amplifier
H. D. Arnold	1,129,942	Mar. 2, 1915	Gaseous Repeater in Circuits of Low Impedance
L. De Forest	1,201,272	Oct. 17, 1916	Telegraph and Telephone Receiving System
F. Lowenstein	1,231,764	July 3, 1917	Telephone-Relay
L. De Forest	1,314,250	Aug. 26, 1919	Method of and Means for Reproducing and Amplifying weak Pulsating Currents
H. D. Arnold	1,329,283	Jan. 27, 1920	Thermionic Amplifier
H. D. Arnold	1,349,252	Aug. 10, 1920	Method of and means for Utilizing Thermionic Currents
L. De Forest	1,375,447	Apr. 19, 1921	Means for Amplifying Currents
L. De Forest	1,377,495	May 10, 1921	Audion-Circuit
H. D. Arnold	1,398,665	Nov. 29, 1921	Thermionic Amplifier
H. D. Arnold	1,403,475	Jan. 17, 1922	VacuumTube Circuits
R. C. Mathes	1,426,754	Aug. 22, 1922	Circuits for Electron-Discharge Devices
R. A. Heising	1,432,022	Oct. 17, 1922	Circuit connection of Electron Discharge apparatus

3633

3634 *Plaintiffs' Exhibit No. 76.*

Inventor	*Patent No.*	*Date of Issue*	*Subject-Matter*
R. C. Mathes	1,442,439	Jan. 16, 1923	Vacuum-Tube Repeater
H. D. Arnold	1,448,550	Mar. 13, 1923	Thermionic Amplifier Circuits
H. D. Arnold	1,465,332	Aug. 21, 1923	Vacuum-Tube Amplifier
D. G. Blattner	1,483,273	Feb. 12, 1924	Circuit for Heating the Filaments of Audions
D. G. Blattner	1,493,595	May 13, 1924	Amplifying with Vacuum Tubes
3635 H. D. Arnold	1,504,537	Aug. 12, 1924	Power-Limiting Amplifying Device
H. D. Arnold	1,520,994	Dec. 30, 1924	Electron-Discharge Amplifier
E. O. Scriven	1,544,943	July 7, 1925	Electric Wave Repeater for Multiplex Transmissions

Plaintiffs' Exhibit No. 76.

WARREN F. HUBLEY
Pres. & Gen'l. Mgr.

Telephone Terrace 4444
4445

3636

AMERICAN TRANSFORMER COMPANY
Makers of Electrical Appliances
174-188 Emmet St., Newark, N. J.

September 13, 1927

(Dictated 9/12/27)

Mr. Ira J. Adams,
Patent Department,
Radio Corporation of America,
#233 Broadway,
New York City.

Dear Sir:

In attempting to market power supply and amplifier units and to sell them to manufacturers

Plaintiffs' Exhibit No. 76. 3637

for use in conjunction with other devices, we are frequently confronted with the question as to whether or not our license agreement on these devices permits their use with anything except a radio broadcast receiver.

In accordance with the license agreement, we are permitted to manufacture and sell only for radio amateur reception, radio experimental reception, and radio broadcast reception; but we have several inquiries for power amplifiers for use with a combination radio receiver and phonograph pick-up. 3638 We have one inquiry which is somewhat urgent for an amplifier to be used for a combination phonograph pick-up and motion picture machine. In this particular device, there will be no radio receiver.

Several weeks ago this matter was discussed with Mr. Norton of your Patent Department over the telephone, as you could not be reached at that time. Our prospective customer is very anxious to get started, but is unwilling to proceed or to place orders with us until we can obtain from the Radio Corporation a statement as 3639 to whether the license agreement can be extended to incorporate the use of power amplifiers with devices other than radio receivers or in combination with radio receivers.

Your early reply will be greatly appreciated.

Yours very truly,

AMERICAN TRANSFORMER COMPANY
J. L. SCHERMERHORN
Chief Engineer.

JLS:CMB/.

3640 *Plaintiffs' Exhibit No. 76.*

September 16th, 1927.

American Transformer Company,
174 Emmet Street,
Newark, N. J.

Gentlemen:

I have your letter of September 13th. Your license permits you to sell power supply and amplifier units for radio use only. The units sold by you are not licensed for electric phono-
3641 graph work nor any other work outside of radio. No one has yet had licenses under our patents to make electric phonographs, or combined radio sets and electrical phonographs, except, of course, we do sell apparatus to the Victor Company that is made into combined radio receiving set and electric phonograph, but this is apparatus made by ourselves. In view of this, people who make electric phonographs or make combined radio sets and electric phonographs are infringers of whatever patents of ours are involved.

3642 The net result of this is that if anyone buys a power supply or amplifier unit from you, he may use it for a radio receiving set but he cannot use it for an electric phonograph, nor can he use it for a combined phonograph and radio set.

A number of our licensees have been requesting that they be given authority to sell the power supply unit for phonograph purposes but we have declined to extend the license in the way requested, as we feel we cannot do this at the present time at least.

Very truly yours,

LJA:CF

PLAINTIFF S' EXHIBIT No. 77

Item 1 Letter from Radio Corporation to American Transformer Company of December 18th, 1930 and attached Schedules A and B

Item 2 Letter of American Transformer Company to Radio Corporation, dated January 5, 1931

Item 3 Letter of Radio Corporation to American Transformer Company, dated April 17, 1931

Item 4 Letter of Arthur Young & Company to Radio Corporation of America of May 15th, 1931

Item 5 Letter of Radio Corporation of America to American Transformer Company of June 10, 1931 and attached schedule

Item 6 Letter of Radio Corporation to American Transformer Company of June 22, 1931

Item 7 Letter of Radio Corporation to American Transformer Company of December 30, 1931 and attached schedules A, B, C and D

Item 8 Letter of Radio Corporation to American Transformer Company of January 7th, 1932

Item 9 Check of Radio Corporation of America to American Transformer Company, dated December 8, 1930; both face and back, the check showing endorsements

Item 10 Check of Radio Corporation of America to American Transformer Company of June 4, 1931; both face and back showing endorsements.

December 18, 1930.

Item 1.

American Transformer Company,
174-188 Emmet Street,
Newark, New Jersey.

Gentlemen:

We have considered the summary as submitted of your sales for the third quarter of 1930 (July, August and September) under the power amplifier and supply license agreement. It is entirely evident to us, and must be equally evident to you, from a consideration of the names of your customers that practically all of such sales have been made to companies which intend to use the apparatus for purposes other than that for which it is licensed, namely, amateur reception, experimental reception and broadcast reception as such terms are defined in the license agreement.

We, therefore, are unwilling to accept your check of $6,018.79 tendered to cover the royalty for this quarter and it is accordingly returned herewith. In lieu thereof, please send us a check for royalties on sales made for licensed uses only. The list shown on the attached Schedule "A" covers, we believe, the only items likely to have been sold for uses under said licenses.

We have also examined your prior statements commencing with July 15, 1930, and find that most of the items therein likewise have been sold to concerns that obviously do not intend to use them for the licensed purposes. The attached list marked Schedule "B" indicates the sales likely to have been made within the licensed field. We return herewith our check for $14,556.36 to cover a refund of the royalties on the remainder which have obviously been sold for uses not within said licenses. Corresponding refunds will also be made for sales for unlicensed uses during prior periods upon receipt of appropriate summaries of your sales for such periods.

77/2

The sale of apparatus for unlicensed uses is an infringement of the patents covering the apparatus. We must protest and insist upon immediate discontinuance of such sales for uses such as for public address systems or in connection with talking motion pictures.

We also take this occasion to notify you that we reserve the right to take appropriate action against your company and/or your customers for infringement arising out of unlicensed manufacture, use and/or sale.

Yours very truly,

SCHEDULE "A

SALES MADE BY AMERICAN TRANSFORMER CORPORATION

DURING 3RD QUARTER OF 1930.

1930		Sold To:	Quantity	Sa
August	5	Vaughan Elect.	1	$58
"	8	Wilmington Elec. Spec.	1	300
"	8	C. K. Deane	1	300
Sept.	29	M. & H. Sptg Goods	1	87
			4	746

Royalty at 7½.....$56

SCHEDULE "B"

SALES MADE BY AMERICAN TRANSFORMER CORPORATION
FOR YEAR ENDED JUNE 30, 1930.

1929		Sold To:	Quantity	Sales	Returns	Royalty
July	12	Dr. I. Litse	1	$261.00		
"	11	Best Mfg. Co.	1	425.00		
"	18	" "	1	425.00		
"	25	" "	1	425.00		
"	5	Wm. Rickey	1	74.00		
"	5	" "	2	114.00		
"	17	Triple Reflecting Arc Lamp	1	36.00		
"	17	" " "	1	57.00		
"	24	Biophone Corporation	1		57.00	
"	24	" "	1		36.00	
Aug.	20	Moffett	1	410.00		
"	13	Theo. Chrisomalis	1	36.00		
"	13	" "	1	57.00		
"	30	Westinghouse Electric	1	57.00		
Sept.	18	Walthal	1	58.50		
			12	2,397.50	93.00	
				93.00		
				2,304.50		172.84
Oct.	11	Marks Brothers	1	68.50		
"	17	A. A. Malen	1	58.65		
"	18	Wholesale Radio Service	1	58.50		
"	21	Platter Cabinet	2	110.00		
"	21	" "	1	240.00		
"	23	G. Wiskimer	1	65.00		
"	15	M. De Vichi	1	40.00		
"	24	Perry Smith	1	36.00		
"	24	" "	1	58.50		
"	24	M. De Vichi	1	65.00		
"	29	Platter Cabinet	1	240.00		
"	31	Doolayphone Company	1	375.00		
"	5	Penn. Storage Battery Co.	1	540.00		
"	7	R. B. Scribner	1		36.00	
"	7	" "	1		57.00	
Nov.	7	S. Baruf	1	720.00		
"	7	"	1	270.00		
"	15	J. A. Adams	1	270.00		
"	21	Doolayphone Company	1	600.00		
"	1	Wholesale Radio Supply	1		57.00	
"	3	Blan	1		36.00	
"	16	Marks Brothers	1		62.50	
"	26	Powers Cinephone	1		540.00	
Dec.	5	International Research	1	500.00		
"	5	" "	1	139.00		
"	21	Radio Service Company	1	65.00		
"	21	" " "	1	40.00		
"	10	Hammerlund Roberts	1	36.00		
"	10	" "	1	58.50		
"	16	Amer. Tel. & Tel. Co.	1	40.00		
"	16	" "	1	65.00		
"	26	Deitz c/o Duncans Co.	1	40.00		
"	26	" "	1	65.00		
"	8	A. A. Malen	1		58.65	
"	18	Platter Cabinet	2		110.00	

1929		Sold To:	Quantity	Sales	Balance	Re
Brought Forward			19	4 851.85	$997.15	
Dec.	18	Platter Cabinet	2		480.00	
			17	4 851.85	1 477 15	
				1 387.15		
				3 414.85		$3
1930						
Jan.	9	Radio Shop of Newark	1	340.00		
"	24	Western Radio Mfg.	1	38.50		
"	30	Sentry Safety Control	1	40.00		
Feb.	14	Thos. V. Gould	1	275.00		
"	7	T. Southwell	1	38.00		
"	7	"	1	38.00		
"	4	Wholesale Radio Service	1	38.00		
"	4	" "	1	38.00		
"	10	" "	1	38.00		
"	17	" "	1	38.00		
"	17	" "	1	38.00		
"	1	M. & H. Sporting Goods	1		40.00	
"	1	" "	1		65.00	
March	3	Otis Elevator Company	1	215.00		
"	3	Audiphone Corporation	1	62.50		
"	18	D. Mackintosh & Son	1	38.00		
"	18	" "	1	38.00		
"	24	" "	1	240.00		
"	1	Wholesale Radio Service	1		38.00	
			13	1,548.00	168.00	
				140.00		
				1,408.00		10
Apr.	9	J. L. Moffett	1	300.00		
"	14	Mover Corporation	1	125.00		
"	30	" "	1	112.50		
May	12	E. M. Zelony	1	340.00		
"	16	J. V. Moffett	1	600.00		
"	16	E. M. Zelonny	1	270.00		
"	15	J. A. Thomas	1	195.00		
June	30	Goodall Elec.	1	62.50		
			8	2,005.00		16
		GRAND TOTAL		9,550.00		69

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Pltff. Ex.-77, Item 2.

Transformer Specialists

Amplifier Equipment

AMERICAN TRANSFORMER COMPANY

176 Emmet St. Newark, N. J.

January 5, 1931.

Pltff Exc 77-2



Radio Corporation of America,
570 Lexington Avenue,
New York, N.Y.

Gentlemen: Attn: Mr. H.C. Grover, Patent Attorney

We are in receipt of your favor of December 31st, returning the checks, and giving us the lists on which royalty is due, and are enclosing our check No. 3267 amounting to $1,079.24, covering schedules A.B.C. & D., referred to in your letter.

We trust you will find this correct, and remain,

Yours very truly,

AMERICAN TRANSFORMER COMPANY

NR/RES.

ENCL: CHECK.

Mr. Grover
Royalty calculated correctly and check deposited
1/6/31

Pltff. Ex. 77, Item 3.

April 17, 1931

Mr. C. F. Loughead, President
American Transformer Company
174 Emmet Street
Newark, N. J.

Dear Mr. Loughead:

This will introduce Mr. C. S. Brison of Arthur Young & Company whom we have assigned to take up the examination of your books and accounts as per the License Agreement dated February 1, 1927.

Yours very truly,

ECA/GM

Pltff. Ex. 77, Item 4.

ARTHUR YOUNG & COMPANY
ACCOUNTANTS AND AUDITORS
1 CEDAR STREET
NEW YORK

CABLE ADDRESS "ARTHYOUNG"
NEW YORK
CHICAGO
PITTSBURGH
KANSAS CITY
MILWAUKEE
LOS ANGELES
DALLAS
DETROIT
TULSA
LONDON, ENGLAND
PARIS, FRANCE

May 15, 1931

RECEIVED
MAY 18 1931
License Division

Pltff Ex 77 It

Mr. Owen C. Anderson,
License Administrator,
Radio Corporation of America,
570 Lexington Avenue,
New York City.

Dear Mr. Anderson:-

AMERICAN TRANSFORMER CO.

We take pleasure in enclosing three (3) copies of our report on the Royalties payable by the above Company under License agreement from February 1, 1927 to March 31, 1931.

We return to you the Licensee's reports loaned to us (Nos. 1 to 15 inclusive) and also enclose reports not previously rendered to you for the quarters ending December 31, 1930 and March 31, 1931. These two (Nos. 16 and 17) together with the four reports next preceding (Nos. 12 to 15 inclusive) show the names of the customers supplied. Our report, therefore, lists the customers supplied only for the eleven quarters prior to September 30, 1929.

As stated in our report the sales records prior to January, 1929 are stated to have been destroyed, so that the figures for the first eight quarters have not been satisfactorily verified by us.

Yours very truly,

Arthur Young & Co.

Encl.

Date	Sold to	Quantity	Type	Model	Amount
1929					
May 16	General Talking Pict. Corp.	6	A 41	#7	360.00
15	" " " "	8	25A	#5	3,400.00
15	" " " "	10	A 41	#7	600.00
10	" " " "	10	A 41	#7	600.00
24	DeForest Phono. Film of Canada	2	A 41	#7	120.00
21	General Talking Pict. Corp.	5	25A	#5	2,125.00
22	" " " "	15	A 41	#7	900.00
27	" " " "	10	25A	#5	4,250.00
24	DeForest Phono. Film of Canada	1	25A	#5	550.00
31	General Talking Pict. Corp.	8	A41	#7	480.00
7	" " " "	7	A 41	#7	420.00
1	" " " "	13	A 41	#7	780.00
31	" " " "	4	25A	#5	1,700.00
June 6	" " " "	1	P.A. 47	#6	225.00
8	" " " "	2	P.A. 47	#6	450.00
12	" " " "	4	P.A. 47	#6	900.00
13	" " " "	1	P.A. 47	#6	225.00
13	" " " "	6	A 41	#7	360.00
13	" " " "	11	25A	#5	4,675.00
11	" " " "	2	P.A. 47	#6	450.00
11	" " " "	12	A. 41	#7	720.00
14	" " " "	8	A 41	#7	480.00
19	" " " "	2	P.A. 47	#6	450.00
20	" " " "	14	A 41	#7	840.00
25	" " " "	1	25A	#5	425.00
24	" " " "	6	A 41	#7	360.00
27	" " " "	12	A 49	#8	480.00
28	DeForest Phono Film of Canada	5	25A 25 Cy.	#5	3,125.00
27	General Talking Pict. Corp.	3	25A	#5	1,275.00
25	" " " "	5	P.A. 47	#6	1,125.00
29	" " " "	3	A 49	#8	120.00
29	" " " "	22	A 41	#7	1,320.00
1	DeForest Phono. Film of Canada	4	25A	#5	2,200.00
4	General Talking Pict. Corp.	4	A 41	#7	240.00

1929

Pltff. Ex. 77, Item 6.

June 28, 1931.

American Transformer Company
178 Emmet Street,
Newark, New Jersey.

Gentlemen:-

Referring to my letter of June 10th it has just been noted that the word "prior" in the second line of the second paragraph should be "subsequent". Will you kindly make this change to correct an inadvertent error.

Yours very truly,

HGG:GC

Pltff. Ex. 77, Item 7.

1228

December 30, 1931.

American Transformer Company,
174-188 Emmet Street,
Newark, N.J.

Gentlemen:-

We have considered the summary as submitted of your sales for the fourth quarter of 1930 (October, November and December) under the power amplifier and supply license agreement. As stated in prior correspondence referring to summaries for other periods it is evident from a consideration of the names of your customers that practically all of such sales have been made to companies which intend to use the apparatus for purposes other than that for which it is licensed, namely, amateur reception, experimental reception and broadcast reception as such terms are defined in the license agreement.

We, therefore, are unwilling to accept your check of $4,452.53, tendered to cover the royalty for this quarter and it is accordingly returned herewith. In lieu thereof please send us a check for royalties on sales made for licensed uses only. The list shown on the attached schedule "A" covers, we believe, the only items likely to have been sold for uses under such license.

For the same reason we are returning herewith your checks for $1178.44, $1180.93 and $1356.60 tendered to cover the royalty for the first quarter, the second quarter and July of 1931. In lieu thereof we likewise request a check for royalties on sales made for licensed uses only and submit herewith schedules "B", "C" and "D" which we believe cover the only items likely to have been sold for uses under such license.

Yours very truly,

H. G. Brower
Patent Attorney.

HGB:CH
Encs.

P.S. The checks mentioned above are returned herewith. The lists referred to will be mailed tomorrow.

Schedule "A"

SALES MADE BY AMERICAN TRANSFORMER CORPORATION

DURING 4TH QUARTER OF 1930

1930	Sold To	Quantity	Sales	Returns
Oct. 3	Balkeit Company	1	85 00	
25	E. M. Zelony	1	351 00	
31	Hoovenir Corporation	1	80 00	
3	E. M. Zelony	1		540 00
3	" "	1		270 00
3	" "	1		540 00
Nov. 11	" "	1	87 75	
11	" "	1	87 75	
21	Linerophone Company	1	87 75	
13	M & H Sptg Goods	1		87 75
1	Hoovenir Corporation	1		80 00
1	C E Deane	1		300 00
Dec. 8	M. & H. Sptg Goods	1	78 75	
3	Geerke Company	1	97 50	
18	Linerophone Company	1	97 50	
16	Assc. Rad. Buyers	1	72 00	
19	W.G. Preddy	1	87 75	
27	M. & H. Sptg Goods	1	82 00	
22	W.G. Preddy	1	87 75	
31	Amer. Tran. Sales Co.	1	156 00	
31	" " " "	1	109 20	
31	" " " "	1	163 80	
31	" " " "	1	156 00	
31	" " " "	1	109 20	
31	" " " "	1	163 80	
31	" " " "	1	176 80	
31	" " " "	1	124 80	
22	United Sound Eng.	1		72 00
22	Fox Elec. Manufacturing	1		87 75

1230

Schedule "B"

SALES MADE BY AMERICAN TRANSFORMER CORPORATION

DURING FIRST QUARTER OF 1931

1931	Sold To	Quantity	Sales
Jan.13	C.W. Mitchell	1	87 75
14	W.G. Preddy	I	87 75
16	W. Va. University	1	97 50
22	M. & H. Sptg Goods	1	81 00
14	Ad. Auriema	1	78 00
23	C.C. Langevin	1	87 75
29	M. & H. Sptg Goods	1	81 00
30	W.G. Preddy	1	87 75
28	Davenport E.	1	97
30	Manus Elec.	2	195
31	Ohio Music	1	78
31	Lincrophone Co.	1	78
Feb. 6	W.G. Preddy	1	87 75
3	E. Markel	1	117 00
3	" "	2	210 00
10	" "	2	210 00
18	Lincrophone Co.	1	97 50
21	Elec. Supply Corp.	1	87 75
18	Hughes - Peters	1	87 75
18	" "	1	72 00
25	Ragon Elec.	1	83 25
20	E Markel	1	105
24	M. & H. Sptg Goods	1	78
Mar. 1	Ad. Auriema	1	78 00
1	Elec. Supply	1	87 75
6	Radio Supply	2	175 50
10	National Union Radio	1	80 00
18	W.G. Preddy	1	87 75
20	" " "	1	87 75
23	" " "	1	87 75
17	Hammarlund Roberts	1	87 75
31	Hughes - Peters	1	87 75
31	Amer. Trans. Sales	1	176
31	" " "	1	124
16	M. & H. Sptg Goods	1	81
Jan. 9	Larus & Bro.	1	200 00
24	Kunsky Trendle	1	200 00
16	Suffolk Elec.	1	200 00
Mar. 2	N.J. Rad.	1	99 00
21	Universal Amp. Co.	1	412 50
21	" " "	1	450 00
21	" " "	1	138 75
21	" " "	1	195 00
25	Island Radio	1	180 00
25	" "	1	138 75
21	Universal Amp. Co.	1	87 75

Schedule "B" Contid.

SALES MADE BY AMERICAN TRANSFORMER CORPORATION

DURING FIRST QUARTER OF 1931.

1931	Sold To	Quantity	Sales	Returns
Mar.31	Radio Air. Serv.	1	225 00	
31	" " "	1	180 00	
31	" " "	1	138 75	
31	" " "	1	412 50	
31	" " "	1	87 75	
31	" " "	1	78 00	
31	" " "	1	252 00	

1232

ROYALTIES - JUNE 1931
ROYALTIES - APRIL 1931

Schedule "C"

1931	Sold To	Sales
Apr. 3	Cross Mfg. Co. - PA-86	87 50
3	Radio Air Serv. - A-36	150 00
3	" " " - P-32	108 75
3	" " " - PA-39	195 00
2	F.A. Boykin - PA-84	48 00
2	Silman Distrib. Co. - PA-86	87 75
10	J.K. Elderkin - PA-84	80 00
7	J.K. Elderkin - PA-86	97 50
10	Western Radio Eng. - P-77	292 50
7	Macon Elec Co. - PA-83	65 25
17	Elec. Supp. Corp. - PA-86	81 00
15	" " " - PA-86	87 75
15	" " " - A-89	81 00
15	" " " - A-89	40 50
16	Graybar Elec. - P-77	180 00
17	C.M. Bowman - PA-85	108 00
20	Radio Air Serv. - 2 Spec. "AP Amp. @ $46 Ea.	92 00
20	Elec. Supp. Corp. - PA-86	87 75
25	Dooleyphone Co. - PA-86	97 50
25	" " - PA-86	80 00
24	American Tel & Tel. - PA-86	105 00
27	Steinman, H. - PA-86	87 75
27	" - 101 Speaker Rect.	25 20
27	Radio Air Service - A-86	72 00
30	Elec. Supp. - PA-86	87 75
30	Officer in Charge - PA83 2 @ $87 Ea.	174 00
25	E.M. Zelony - A-80	202 50
24	H. Steinman - P-78	42 75
24	Radio Air Service - PA-64	550 00
24	" " " - 2 - 2AP @ $46 Ea.	92 00
30	H. Steinmann - PA-86	87 75
30	" " P-101 a @ $25.20 Ea.	50 40
1933 CREDITS		
14	E. Markell - A-72	105 00
14	" " - a "-83 @ $105. Ea.	210 00
15	Ad. Auriema - P-83	49 88
	" " - PA-84	55 04
	" " - PA-85	61 92
	" " - PA-86	66 08
	Wilmington Elec. - P-81	300 00

Schedule "C" Contd.

ROYALTIES -- MAY 1931.

1931	Sold To	Sales
May 1	Independent Radio	97 50
2	Mr. Knowles - PA-84 S	80 00
4	Amusement Supp. - A-67	180 00
	" " - P-63	138 75
1	Radio Air Serv. - A-67B	140 40
	" " " - P-63B	108 22
2	Bell Tel. Lab. - P-106	160 00
7	C.C. Langevin - P-108	85 00
11	W.G. Preddy - PA-86	87 50
14	Elec. Supply Co. - 2 PA-86 @ $87.75 Ea.	175 50
16	R.V. Terry - PA-86	97 50
14	Radio Air Serv. - PA-86	87 75
	Ad. Aurieme - PA-86	78 00
20	Cross Mfg. - PA-86	97 50
	C.C. Langevin - PA-86	87 75
21	E.M. Zelony - PA-86	87 75
20	Amusement Supp. - A-67	180 00
	" " - P-63	138 75
18	Electro Sound Prod. - PA-84	80 00
26	Wireless Egert - PA-84	72 00
27	Emmanuel Miss. Coll - PA-86	117 00
	" " " - A-88	96 00
29	Bay Smith Co. - PA-86	97 50
CREDITS:		
13	T.V.Gould-PA-61	275 00
23	Good-all Elec. - A - A-53 @ $86.Ea	156 00
29	Elec. Supp. Co. - PA-86	87 75
		1719

Schedule "C" Contd.

ROYALTIES - JUNE 1931

1931	Sold To	Sales
June 5	Electro-Phone Corp. - PA-86	87 75
3	Sun Radio Co. - PA-85	85 25
	Elec. Supply Corp. - A-89	40 50
	" " " - A-89	40 50
	" " " - PA-85	81 00
	L Deane - PA-86	87 75
5	Universal Amplifying Co. - PA-86	87 75
9	L.E. Wyant - PA-86	97 50
10	Ad. Auriema - PA-86	78 00
9	H.H. Steinman - PA-86	87 75
10	E. Markell -RA89 @ $54. Ea.	108 00
8	H.N. Steinman - P-101	42 00
5	Hughes-Peters Elec. P-101	25 20
13	Simplimus - A-89	45 00
	" - PA-86	90 00
11	Elec. Serv. Supp. - PA-84	80 00
16	Simplimus, Inc. - PA-85	90 00
17	George Rogers - PA-86	87 75
16	H.N. Steinman - PA-84	72 00
	" " - P-101	25 20
20	Simplimus - A-89	67 50
	" - PA-85	90 00
16	C.C. Langevin - PA-86	81 00
17	Elec. Serv. Supp. - A-88	80 00
23	L.E. Wyant - A-88	80 00
23	Ad. Auriema - A-88	64 00
20	E. Markell - A-89	45 00
	" " - A-86	97 50
22	S.L. Baraf - 2 PA-86 @ $87.75 Ea	175 50
24	Electro-Fone Corp. - PA-84	72 00
25	Ranier Mfg. Co. - PA-86	87 75
25	Universal Amplifying - PA-86	87 75
26	Electro Sound Products - PA-84	72 00
25	Elec. & Radio Distrib Co. - A-36	150 00
	" " " " - P32	108 75
	" " " " - PA-39	195 00
	" " " " - A-80	225 00
	" " " " - P-102	117 00
CREDITS		
12	Radio Air Service - PA-84	550 00
15	Markein To correct invoice	(18 00)
24	H.N. Steinman - To correct invoice	(16.80)

77/20

Schedule "D"

ROYALTIES FOR JULY 1931

1931	Sold To	Sales
July 10	Ad. Auriema - 1 PA-83 Amplifier	58 00
9	Pacific Gas & Elec. Co. 1 PA-86 Ampli.	87 75
9	Eugene Gwile 1 PA-86 Amp,	81 00
14	Brown & Maine 1 PA-86 Amp.	97 50
3	Draclair Amusement Co. 1 PA-86 Amp.	97 50
15	Radio & Elec. Distributors 1 PA-83 Amp.	87 75
22	" " " 1 A-88	80 00
20	Wenger-Brill Co. 1 PA-86 Amp.	87 75
24	Renier Mfg. Co. 1 PA-86 Amp.	87 75
24	D'Elia Elec Co. 1 PA-85 Amp.	81 00
	" " " 1 A-88 Amp.	72 00
27	M. & H. Sporting Goods 1 PA-84 Amp.	77 00
28	W.G. Preddy 1 PA-86 Amp.	87 75
31	C. Alvord 1 PA-83 Amp.	87 00

LESS CREDITS:

22	Western Rad. Eng. P-77 billed 4/10 $292.50 should be $200 -	$92.50
29	Radio & Elec. Dis. 1-A-88 Amp.	80.00
31	Elec-tro-fone Corp. ---------- 1-PA86	87.75

77/21

1236

Pltff. Ex. 77, Item 8.

January 7, 1932.

American Transformer Company,
178 Emmet Street,
Newark, N.J.

Attention Mr. Chas. F. Loughead.

Gentlemen:-

We acknowledge receipt of your letter of January 5th and the accompanying check for $1,079.24 covering royalties in connection with the power amplifier and supply license.

Yours very truly,

H G Greene
Patent Attorney.

HGG:GC
cc- E C Anderson

RECEIVED
JAN 9 - 1932
License Division

RADIO CORPORATION OF AMERICA

NATIONAL BANK OF COMMERCE 1-23
NEW YORK

No. 76070

December 9, 1930

EXACTLY 14534 & 39 CTS

$14534.39

Pay
TO THE
ORDER
OF

American Transformer Corporation

Frank Ebersole

F. V. Hoffman

RECEIVED PAYMENT
JUL 25 1931
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Pltf. Ex. 77, Item 9.

1232

RADIO CORPORATION OF AMERICA

NATIONAL BANK OF COMMERCE 1-23
NEW YORK

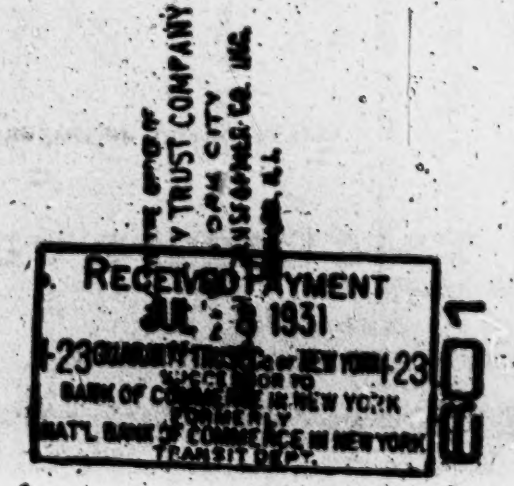
No. 78696

June 4, 1931

EXACTLY 6410 & 25 CTS

$6410.25

American Transformer Company



Pltff. Ex. 77, Item 10.

PLAINTIFF S' EXHIBIT No. 18 1239

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Forfeited.

DIV. 16 1914 (EXT'S BOOK) 21 26

NUMBER (Series of 1900).

841567 PATENT No.:

Name Harold De Forest Arnold assignor to Western Electric Company, Incorporated, New York, N.Y., a corp. of N.Y. New-York.

of East Orange,
County of
State of New Jersey.
Inventions Audions

	GENERAL	RECEIVED
Petition	May 28, 1914	, 191
Affidavit	" , 1914	, 191
Specification	" , 1914	
Drawing	" " , 1914	
Photo Copy	June 4, 1914	
First Fee Check	$15 May 28, 1914	
" " Cert	, 191	
Appl. filed complete	May 28, 1914	

This application referred to in Patent No. 1354934

Do not destroy. (See order No. 3166, 400 O.G. 1)

Examined and Passed for Issue Oct. 23, 1918

W. D. Backus Exr. Div. 16 Exr. Div.

Notice of Allowance	Oct. 2, 1918	, 191
Final Fee Check	, 191	, 191
" " Cert	, 191	, 191
Patented		, 191

Attorney De Witt C. Tanner, 111 West Street, Address 92 Broadway, New York City, N.Y.
Associate Attorney John S. Roberts, 111 West Street, 220 Broadway, New York City, N.Y.

No. of Claims Allowed 20 Title as Allowed Audions

(Cl. 4 1)

IC 250-27

Sale

E'

TO ALL WHOM IT MAY CONCERN:

Be it known, that I, HAROLD DeFOREST ARNOLD, a citizen of the United States, residing at East Orange, in the County of Essex and State of New Jersey, have invented certain new and useful improvements in Audions, of which the following is a full, clear, concise and exact description.

This invention relates to thermionic repeaters, such as the audion,

 76/2

and its object is to provide a structure of increased efficiency and of either low-current and high-voltage or high-current and low-voltage output, as may be desired.

It has been discovered that by arranging the input electrode or grid as closely as possible to the cathode or filament the efficiency of the audion is greatly increased. It has also been discovered that, by properly adjusting the position of the output electrode or plate with respect to the filament, the output current and voltage of the audion can be controlled. It has also been discovered that the amount of obstruction the input electrode presents between the output electrode and the filament is also a factor in controlling the output current of the audion. In accordance with this invention, therefore, it is possible to improve the efficiency of the usual high-voltage output type of audion and to provide an audion distinctly new in type, having a high-current and low-voltage output.

The several features of this invention may be more readily understood by reference to the accompanying drawings in which,-

Fig. 1 is a perspective view of an improved audion having a low-current and high-voltage output;

Fig. 2 is a top plan view illustrating the relative position of the input and output electrodes and the filament shown in Fig. 1;

Fig. 3 is a fragmentary perspective view of the new type of audion having a high-current and low-voltage output;

Fig. 4 is a top plan view illustrating the relative position of the input and output electrodes and the filament shown in Fig. 3; and

Figs. 5 and 6 are views corresponding to Figs. 3 and 4, respectively, of a modified structure of the afore-

mentioned new type of audion.

Like reference characters refer to like parts throughout the several views.

Referring first to Figs. 1 and 2, the input electrode or grid 1 is placed as closely as possible to the filament 2. It has been found that the closer these two elements are placed together, the stronger the electric field and the more efficient the action of the audion. In practice it has been found that when the two elements are placed side by side or so closely placed together that a mere oxidizing coating on the one or the other is relied upon to electrically separate the same, the most efficient action is secured.

It has furthermore been discovered that the distance between the filament and the output electrode or plate 3 is an important factor in the voltage output of the audion. Within working limits, the farther the plate is located from the filament, the higher becomes the voltage. Another factor entering into the output voltage is the structure of the input electrode or grid 1, the more obstruction the electrode 1 offers between the filament and the output electrode the higher the output voltage. In Fig. 1, the input electrode 1 is shown as consisting of a grid having a very fine mesh interposed between the filament 2 and the plate 3, such being the preferred construction in this high-voltage output type of audion.

In the aforementioned high-voltage output type of audion illustrated in Figs. 1 and 2, in order to secure the most efficient structure, the input electrode or grid 1 should be as near as possible to the filament, the output electrode or plate should be distant from the filament, and the input electrode or grid should present a finely divided or meshed

surface between the filament and plate. The filament need not present a very large active area. An audion having such structure will give a high degree of amplification, the output thereof being a low current with a high voltage.

As contrasted with the improved audion of the usual high-voltage output type shown in Figs. 1 and 2, is the new high-current output audion illustrated in Fig. 3 and 4 and Figs. 5 and 6, respectively. In such new type, the input electrode or grid 1^B is placed as close as possible to the filament 2^B in order to secure the greatest efficiency, in this respect the high-current output audion resembling the improved high-voltage output audion hereinbefore described. In this high-current output type, however, the plate 3^B is placed as close to the filament as is conveniently possible, since the effect of advancing the plate towards the filament is to lower the output voltage of the audion. As hereinbefore stated, another factor controlling the output voltage is the input electrode or grid 1^B, which should offer minimum obstruction between the plate and filament. In Figs. 3 and 4, the input electrode is shown as a grid 1^B having a very coarse mesh.

In Figs. 5 and 6, there is shown another modification of the low-voltage output audion, certain of the specific details thereof being the invention of another and forming the subject matter of a copending application. In said Figs. 5 and 6, the input electrode is in the form of a wire 1^B bent back at its middle. In effect, therefore, the input electrode consists of two wires joined together. The filament 2^B is entwined about the input electrode and is insulated therefrom by a tube of insulating material 4, . The output anode consists of two plates 3^B, 3^B arranged upon opposite sides of the filament close thereto. It will be

noted that the input electrode is not located between the filament and plate, such not being necessary for efficient action in this high-current output type of audion.

Referring to the audion structures illustrated in Figs. 3 and 4 and Figs. 5 and 6, respectively, it will be noted that the greatest efficiency is attained by placing the input electrode as near as possible to the filament, by placing the plate near to the filament, by providing a large filament area, and by so constructing and locating the input electrode that it presents the least possible obstruction between the filament and output electrode or plate. It has been found that in accordance with this invention, an audion may be constructed which will ~~step down the input voltage to one-third of its original value~~, that is, the audion will have an output of high current and low voltage. Such new type of audion, because of its low output impedance, as low, for example, as 500 ohms, can be worked efficiently into a line of like impedance.

Insert A

A combination of the two types of audions above described, to provide a very efficient amplifying means which can be directly connected in a line of low impedance, forms the subject-matter of a copending application of even date herewith.

By thermionic repeater is meant a repeater depending for its operation upon current discharge from a heated cathode. The invention is illustrated and claimed herein as applied to the audion which is believed to be the best type of thermionic repeater. In its broadest aspect, however, the invention is not limited to the particular structure herein illustrated but may be found useful in modified forms or types of thermionic repeaters.

What is claimed is:

1. An audion having its input electrode in immediate proximity to its filament but out of electrical contact therewith.

2. An audion having its input electrode and filament arranged as close together as possible and separated by insulating material.

3. An audion comprising an input electrode, an output electrode and a filament, said output electrode being located so close to the filament as to step down the output voltage of said audion.

4. An audion comprising an input electrode, an output electrode and a filament, said input electrode being located as close as possible to said filament but out of electrical contact therewith, and said output electrode being very slightly spaced apart from said filament, thereby conducing to an amplification of current in the output of said audion.

5. An audion comprising an input electrode, an output electrode and a filament, said input electrode being in immediate proximity to said filament but out of electrical contact therewith, said filament having a large area, and said output electrode being so slightly spaced apart from said filament as to conduce to an amplification of current in the output of said audion.

6. An audion comprising an input electrode, an output electrode and a filament, said output electrode being located so close to the filament as to step down the output voltage of said audion, and said input electrode offering minimum obstruction between the output electrode and filament.

7. An audion comprising an input electrode, an output electrode and a filament, said input electrode offering

minimum obstruction between said output electrode and filament and being located in immediate proximity to said filament but out of electrical contact therewith, and said output electrode being very slightly spaced apart from said filament.

8. "An audion comprising an input electrode consisting of a grid having a very coarse mesh, an output electrode and a filament, said grid being located as close as possible to said filament but out of electrical contact therewith, and said input electrode being located so near to said filament as to conduce to an amplification of current in the output of the audion.

9. An audion having its input electrode and filament arranged in close proximity and separated by a film of insulating material.

10. An audion having an input electrode and filament, and a film of insulating material carried by one of said elements and with which the other element contacts.

11. An audion having an input electrode and a filament, and an interposed separating film of non-conducting material in contact with both.

In Witness Whereof, I hereunto subscribe my name this 25 day of May A. D., 1914.

Witnesses:

E Eller

K L Hall

Harold DeForest Arnold

State of New York }
County of New York } ss.

HAROLD DeFOREST ARNOLD, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and resident of East Orange in the County of Essex and State of New Jersey and that he verily believes himself to be the original, first, and sole inventor of the improvement in Audions described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in the United States of America or any foreign country before his invention or discovery thereof or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application, and that no application for foreign patents has been made by him or his legal representatives or assigns in any foreign country.

Harold DeForest Arnold

Sworn to and subscribed before me this 25th day of May 1914.

Ella Eller

Notary Public.

1218

Dec 16, 1904. 305 1m

DEPARTMENT
UNITED STATES
WA

John G. Roberts,
463 West St.,
New York, N. Y.

Please find below a communication from
H. D. Arnold, Serial No. 861
Audions.

Thomas Ewing

This case has been exam
The following reference
de Forest, 879,5
Stone et al, 884,1
"The Wireless Tele
second edition, 19
Co., 233 Fulton St

The use of the term out
and claims is criticised bec
section of the audion and in
14, page 5, that the audion
to one-third of the original
ceiver circuit of an audion
battery in the receiver circ
de Forest and Stone, cited.
to affect the passage of ele
ceiver circuit and in that v
in the receiver circuit. W
apparently in the potential

Paper No. 2

[illegible]

F THE INTERIOR
PATENT OFFICE,
INGTON August 17, 1914.

U. S. PATENT OFFICE
AUG 17 1914
MAILED

[illegible] in charge of the application of
367, Filed May 28, 1914, for

[signature]

ed and considered.
are made of record:
, Feb. 18, 1908, 250-27-X
), Apr. 7, 1908, " -27.
one," No. 2, by H. Gernsback,
, published by Modern Publishing
et, N. Y. City.
t voltage in the specification
se it implies a transformer
et it is stated in lines 13 and
ill, step down the input voltage
alue." The voltage of the re-
thought to be governed by the
, as e. g. the battery B in
he only effect of the audion is
rossacross the gap in the re-
set up variations of current
is meant by out-put voltage
or between the filament and plate,

or out-put [illegible].

The specification and claims
especial attention being directed
lines 13 and 14, page 5, and line
The sentence beginning in li
erased since another's invention
has become a patent.
The [illegible] description of Figs. 5 an
page 4 is thought to be in error
and 2b as the hot wire filament:
reversed.
The reference to the copending
paragraph on page 5, should be ind
if not, the reference should be co
Claims 1 to 9 are rejected on
attention being particularly calle
"Wireless Telephone" in which an au
filament and plate spaced 3 millim
midway there between. Such terms
"as close as possible" are indefin
distinguish from the art cited.
The expression "amplification
4, 5 and 8, is objected to. The c
is generated by the battery in suc
varys this current. The expressio
"changes (or variations)" is though
Claim 9 does not distinguish
an air gap between the filament a
of oxid on the filament or grid.
Claims 10 and 11 are allowed

CSG

hould be corrected accordingly

o lines 17 and 18, page 3,

, claims 3 and 4.

18, page 4, should be

y only be referred to after it

6 in the last paragraph on

describing in on the grid

hese elements are evidently

application in the second

ntified, if filed by applicant;

ceied.

either of the references cited,

to pages 64 and 65 of the

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"immediate proximity" and

te and vague and fail to

f current" in line 8, claims

rent in the receiver circuit

circuit and the audion merely

"amplification of current

to be accurate.

on the references which have

grid in addition to the film

Sidney J. Smith.

Examiner, Div. 16.

1250

PAPER NO. 3
AMENDMENT A

MAIL ROOM SEP 1914 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE
Division 16 - Room 309.

In re application of
Harold DeForest Arnold
Serial No.841,567.
Filed May 28, 1914.

Audions.

PATENT OFFICE SEP 22 1914 DIV. 16 FILED

COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

In response to Office action dated August 17,1914, please amend the above entitled application as follows:

Page 4, lines 24 and 25, erase "being" down to "application" and substitute --not being the invention of this applicant--; line 30, erase "the"(first occurrence) and substitute --a tube of--.

Page 5, lines 13 and 14, erase "step down" to "original value" and substitute --develop amplified energy at a voltage one-third of the voltage of the input energy--

A' Per E

Erase all of the claims and substitute therefor the following:

A² Sub. C' Per E

1. A thermionic repeater having its input electrode in immediate proximity to its cathode but out of electrical contact therewith.

2. A thermionic repeater having its input electrode and cathode arranged as close together as possible without contacting.

3. A thermionic repeater having its output electrode arranged so close to its cathode as to develop output energy at a voltage lower than the voltage of the input energy.

4. A thermionic repeater having its output electrode arranged so close to its cathode that the

space impedance between said elements has an operating value not exceeding approximately 500 ohms.

5. A thermionic repeater having its input electrode in immediate proximity to its cathode but out of electrical contact therewith, and its output electrode arranged so close to said cathode as to develop amplified energy at high current and low voltage as compared with the current and voltage of the input energy.

Sub C 2

REMARKS

Claims 10 and 11 which had been allowed have been erased because they describe a structure that is not the invention of this applicant. They were included in this application by this inadvertence and are now inserted, in modified form, in another application of the same assignee.

The description of Figs. 5 and 6 in the last paragraph of page 4 is believed not in error. In this embodiment of applicant's invention the input electrode is the wire 1^b within the tube 4, and the heated cathode is a filament in the form of the spiral wire 2^b entwined about the tube, as stated in the specification.

The objection to the expressions amplification of current, output and input voltage and current, etc., is believed not well taken. These expressions are commonly used in describing the characteristics of audions and other forms of repeaters, and no better expressions are known which may be substituted therefor. The action of the audion and particularly of the one described in this application is in fact similar, or analogous at least, to that of a transformer. Of course the output energy is not derived so directly from the input energy as in a transformer, but nevertheless the input energy has certain voltage and current characteristics and the output

energy may have certain other voltage and current characteristics, so that it seems proper to refer to the action as amplification of current or amplification of voltage, as well as amplification of energy. It is true to a certain extent, as stated in the Office letter, that the voltage of the receiver (output) circuit of an audion is governed by the battery in the receiver (output) circuit, but it is not usual and certainly misleading to speak of the output voltage as being a function of the voltage of the battery in the output circuit. Rather, the output voltage is the voltage of the alternating or fluctuating current impressed upon the circuit of that battery. That is to say, the only effective output voltage is the alternating current potential developed between the filament and plate. This may be of, and ordinarily has, a very different value from the voltage of the battery itself.

It is also true in a sense, as stated in the Office letter, that the only effect of the audion is to affect the passage of electrons across the gap of the receiver (output) circuit, and in that way to set up variations of current in the receiver (output) circuit. It is, however, also true that this phenomenon manifests itself as a superimposed alternating potential across the gap and a fluctuation of current in the circuit. If we consider the output circuit as connected inductively with an outgoing line, we can see clearly enough that the only energy available in the outgoing line is that due to this alternating potential and alternating current, developed in the output circuit by the input energy acting through the input electrode.

The suggestion that the expression "amplification of current changes or variations" is thought to be more accurate than "amplification of current" is not believed to be well taken. It is thought to be meaningless to refer to the amplification of changes of current. The audion as well as other forms of

amplifiers, deals with real quantities. It is electrical energy, the product of current and voltage, which is amplified.

The substituted claims are in the best form that applicant knows of to express his invention. It is no doubt true that the terms "immediate proximity" and "as close as possible" would be objectionable if more definite expressions could be used. In respect to the present invention, however, there does not appear to be any other language adequately to describe it. The invention is based upon a discovery of very great importance, i.e., the closer the input electrode and cathode are placed together, the more efficient is the action of the audion. Higher efficiency in the audion means a higher amplifying ratio, and is greatly to be desired. Heretofore, as in the references cited, the input electrode or grid was simply arranged approximately midway between the cathode and the output electrode or anode. There was no effort to arrange the input electrode in immediate proximity, or as close as possible, to the cathode, and no one before applicant so far as known had any idea that this would produce beneficial results. It is persuasive of the great merit of applicant's invention that certain forms of audions have been developed since applicant's invention was made, and on the basis thereof wherein to secure the maximum efficiency, the input electrode has been placed as close as approximately .001 of a millimeter from the cathode without electrically contacting with it. Applicant shows two embodiments of the invention in which the input electrode and filament are arranged adjacent each other in space and maintained by careful construction and rigid mounting as close together as possible, but out of electrical contact with each other. He has also shown in Figs 5 and 6 a modified [illegible] of the invention in which a small tube of [illegible] is placed about the input electrode, the filament being [illegible] the tube. By making the walls of this tube [illegible] small dimensions, the filament may be maintained [illegible] close to the input electrode.

Particular emphasis seems to be given in the Office action to the Wireless Telephone, wherein is described an audion having a small platinum plate fastened approximately 3 millimeters from the filament, and a grid placed nearly midway between the two. A very crude from of the audion is illustrated and there seems to be no means in this device for insuring that these elements shall not come in contact with each other during use. It is not stated in this book that there is any advantage at all in placing the elements close together, and it is not believed that there was meant to be described in this book an audion having a very high efficiency by reason of close proximity of the elements, one to the other. Furthermore, the distance apart of the elements is far too great, even when the 3 millimeters distance between the plate and filament is divided by 2 and lessened by the thickness of the grid wire, to produce the very efficient results secured in audions made according to applicant's invention wherein the input electrode is placed as close as possible or in immediate proximity to the filament. It is not believed that such a crude construction as described in this publication, which is admitted to be a device "yet in an undeveloped stage", should be considered as anticipating the highly developed structures embodying applicant's invention and based on such an important and far reaching discovery.

The pertinency of the other two references cited is not at all apparent and with the revised claims the application is believed to be in condition for allowance.

In view of the close relationship of the present application to other applications relating to like subject matter and assigned to the same assignee, it is requested that this application be made special and acted upon as soon as possible.

Respectfully,
H. D. ARNOLD,

By _____
Attorney

463 West Street,
New York, September 17, 1914.

JIn-E

MAIL ROOM OCT 10 1914

PAPER NO. 4
AMENDMENT B

UNITED STATES PATENT OFFICE
Division 16, Room 909

In re application of
Harold DeForest Arnold
Serial No. 841,867
Filed May 28, 1914

Audions

INTERF. OFFICE
OCT 17 1914
DIV. 16 FILED

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

Please further amend this application as follows:

Page 4, line 10, after "efficiency" insert a comma; same page, line 25, change "low-voltage" to --high-current--; lines 23 and 24, place a period after "audion" and cancel the remainder of the sentence; same page, line 30, after "4" place a comma and insert:

--an arrangement which is not the invention of this applicant, but is described and claimed in a copending application in the name of Alexander McLeod Nicolson, Ser. No. 863,200 filed September 25, 1914 and assigned to the same assignee as the present application.--

Page 5, line 22, after "application" insert --in my name, Ser. No. 841,867 filed--.

Respectfully,

HAROLD DeFOREST ARNOLD.

By [signature]
Attorney

B' Pele

463 West Street,
New York, October 7, 1914.

7810

1256

Div. 16 Room 109 — 2-200 — Paper No. 5

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

FK

All communications respecting the application should give the serial number, date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Nov. 2, 1914.

U. S. PATENT OFFICE NOV 2 1914 MAILED

John C. Roberts,
462 West St.,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

Harold De Forest Arnold, S.N. 861,867, filed May 22, 1914.

Commissioner of Patents.

In response to amendment filed October 10, 1914.

Applicant's argument has been carefully considered, but the examiner is not convinced that the broad claims submitted in any way distinguish from the prior art as exemplified by the references of record.

The terms "immediate proximity" and "as close together as possible" are merely relative and wholly insufficient to distinguish from the references. In the audion described in the pamphlet "The Wireless Telephone" the cathode and the grid are only one and one-half millimeter minus one-half the thickness of the grid apart. This is obviously an extremely small space and as applicant states in his argument they may be so close together as to at times come in contact. If so, they are clearly as close together as it would be possible to place them, but on the other hand, it is held that the structure as disclosed is clearly operative and that it will anticipate any claim that will read upon it. Applicant further states in his remarks that the distance in these references is far too great, if this is true limitations should be put in the claims so that they will distinguish from the references by structure rather than by vague and indefinite terms.

7/8

The claims are each accordingly rejected.

Claim 3 is further rejected as being inaccurate and misdescriptive in reciting that the output electrode and cathode are arranged so close together as to develop output energy at a low voltage. Nowhere in the specification is it stated that merely placing the grid and cathode close together will have any effect on the output voltage. On the other hand, the specification states that the output voltage is determined by the distance between the output electrode and the cathode and by the amount of obstruction offered by the grid. It appears therefore that the small distance between the cathode has little, if any, effect on the output voltage, and claim 3 is accordingly misleading and misdescriptive.

ALG

Wm A Kinnan

Examiner Div. 16.

1258

MAIL ROOM FEB 4 1915

PAPER NO. 6
AMENDMENT C

UNITED STATES PATENT OFFICE
Division 16 - Room 109

In re. application
Harold DeForest Arnold.
Serial No. 841, 867.
Filed May 28, 1914.

Audions.

PATENT OFFICE
FEB 5 1915
DIV. 16 FILED

COMMISSIONER OF PATENTS:
Washington, D.C.

Sir:

In response to the Office action of November 2, 1914, please amend the above entitled application as follows:

Cancel claims 1 and 2 and substitute therefor the following:

--1. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode in immediate proximity to said cathode but out of electrical contact therewith and closer to said cathode than to said output electrode.

2. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode as close as possible to said cathode without contacting therewith and closer to said cathode than to said output electrode.--

Cancel claim 3 and substitute therefor the following claim:

--3. A thermionic repeater having its output electrode arranged so close to its cathode as to

develop output energy at a voltage lower than the voltage of the input energy and having its input electrode arranged closer to said cathode than to said output electrode.

6. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said output electrode and said cathode being so spaced apart and the amount of obstruction offered by said input electrode being such as to develop output energy at a voltage differing from the voltage of the input energy by a predetermined ratio.

Sub. D

7. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said output electrode and said cathode being so spaced apart and the amount of obstruction offered by said input electrode being such as to develop output energy at a predetermined voltage lower than the voltage of the input energy.

8. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said input electrode being arranged much closer to said cathode than to said output electrode, and said output electrode and said cathode being so spaced apart and the amount of obstruction offered by said input electrode being such as to develop output energy at a voltage differing from the voltage of the input energy by a predetermined ration.--

Per E.

Per S

R E M A R K S.

A reconsideration of claims 3 and 4 without amendment is respectfully requested. From the last paragraph of the Office action, it would seem that the Examiner misread these two claims, since reference is made by him to "placing the grid and cathode plane together". Such an arrangement of the grid and cathode

is not set forth in claims 3 and 4, but said claims are directed to such an arrangement of the output electrode or plate and the heated cathode as will develop a voltage lower than the voltage of the input energy.

A further consideration of all the claims is respectfully requested. As pointed out in the specification, there are three factors involved in applicant's present invention. One is the placing of the grid or input electrode as close as possible to the cathode or heated filament. This is desirable as giving the best results whether embodied in the one or the other of the two novel types of thermionic repeaters disclosed in the present application. The output voltage varies directly with the distance between the output electrode or plate and the heated cathode, this being the most important factor for determining the output voltage. The output voltage also varies inversely as the distance between the wires of the grid, that is, the less obstruction the grid offers, the lower the output voltage. Therefore, for the production of the best possible thermionic repeater of either of the new types disclosed in the specification, it is desirable that all three of the above mentioned factors be taken into consideration, though satisfactory results can be obtained merely from taking into consideration one only of such factors. The claims are now believed to fully distinguish from the references of record. For example, in the audion described in "The Wireless Telephone" the grid is located midway between the heated filament and the plate, which is the same relative arrangement of the parts as are shown in the Stone and DeForest patents, cited. In the case of applicant's invention, as set forth in the claims, there is a different relative arrangement designed to produce distinctively different results. As set forth, for example, in claim 1, the grid is much closer to the heated cathode than it is to the plate. Either one or more of the distinguishing features of applicant's invention are set forth

in each of the claims, which claims now fully distinguish from the audion structure described in "The Wireless Telephone" and in the DeForest and Stone patents of record.

Respectfully.

HAROLD DeFOREST ARNOLD

By A. C. Dannet.

Attorney

463 West Street,

New York Feb. 3, 1915.

CEP:AL

1262

Dev. 16 Room 187 — 2-200 — Paper No. 7

Address only The Commissioner of Patents, Washington, D. C., and not any official by name.

All communications regarding this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Feb. 16, 1915.

Mr. John G. Roberts,
403 West Street.
New York, N. Y.

PATENT OFFICE
FEB 16 1915
MAILED

Please find below a communication from the EXAMINER in charge of the application of

H. deF. Arnold, S. No. 841,557, filed May 28, 1914.

Audions.

Thomas Ewing
Commissioner of Patents.

This action is in response to amendment filed Feb. 4, 1915.

The following references are added to the record:

Pierce 1,112,655, Oct. 6, 1914, 250-27.X.
Schlocmilch et al, 1,087,892, Feb. 17, 1914, " " "

Attention is directed to the specification of Pierce, line 16, et seq., page 3, in which it is stated that the voltage of the batteries in the out-put circuits of audions depends, among other things, upon the distance between the cathodes and anodes and screens in the vessel and also upon the size of the mesh of the screens. A similar statement is made in the patent to Schlocmilch in the sentence beginning in line 97, page 1. It therefore appears that the potential drop between the cathode and anode of an audion depends upon the voltage of the battery in the out-put circuit and that it has been known prior to the present application that this potential drop is smaller the smaller the distance between the two terminals. Claims 3, 4, 6 and 7 are accordingly rejected on either of the references above cited. Since it is well known that the voltage of

the out-put circuit varies with the distance between the out-put terminals, there would be no invention broadly in making this distance so small that the out-put voltage would be less than the in-put voltage or that the space impedance between the two terminals would be less than five hundred ohms.

Claim 6 and 7 are further rejected as being functional and indefinite.

Claim 8, line 8, the last word is misspelled.

Claims 1, 2, 5 and 8 are allowed

Wm A Kinnan
Examiner, Division XVI.

RAS

1251

PAPER NO. 8
AMENDMENT

MAIL ROOM FEB 25 1915 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE
Division 16 - Room 109

In re application of
Harold DeForest Arnold,
Serial No. 841,567,
Filed May 28, 1914.

Audions.

PATENT OFFICE
FEB 26 1915
DIV. 16 F.L.

COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

In response to the Office action of February 16, 1915, please amend the above entitled application as follows:

Cancel claims 6 and 7 and substitute therefor the following claims:

--6. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said input electrode being arranged closer to said cathode than to said output electrode, and said output electrode and said cathode being so spaced apart as to develop output energy at a voltage differing from the voltage of the input energy by a predetermined ratio.

7. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said input electrode being arranged closer to said cathode than to said output electrode, and the amount of obstruction offered by said input electrode being so low and the output electrode being arranged so close to said cathode as to develop output energy at a voltage lower than the voltage of the input energy by a predetermined ratio.--

Claim 8, last line change "ration" to --ratio.--

A reconsideration of claims 3 and 4 without amendment is respectfully requested.

Claims 6 and 7 have been rewritten to free them from the objections specified in the Office action.

Claims 3, 4, 6 and 7 are believed to clearly distinguish from the Pierce and Schlesinger et al patents of record.

It is evident that Pierce, in stating that the voltage of the battery depends upon certain factors means that in operating a given device the best value of the D.C. of battery voltage can be found by trial and that the variation of distances and mesh would vary this best or most suitable battery voltage.

Claims 3, 4, 6 and 7 are directed to the ratio of available output alternating current voltage to the input alternating current voltage. This, in accordance with applicant's invention, is entirely independent of the direct current or battery voltage, (the alternating current voltages being always kept, of course, within reasonable limits). Pierce nowheres refers to the ratio of alternating current voltages nor does his patent give any hint of the possibility of such ratio being predetermined. He merely mentions a means by which a given device can be made to operate as satisfactorily as possible in a given circuit, and states that this adjustment varies with the device in question.

In the patent to Schlesinger et al, it is stated that the "amplitude" depends upon the potential of the auxiliary source of current, (Page 1, lines 102-103). Thus the voltage of the battery or source of direct current is called upon to produce the "amplitude". Applicant, of course, uses a battery in connection with his thermionic repeater and naturally adjusts the battery to a correct value, but he constructs the tube to get "amplitude". For example, in accordance with applicant's invention, it is possible to have two tubes in connection with which batteries or sources of direct current having the same voltages may be employed and having the same input alternating current voltage, and

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nevertheless in the case of one tube obtain an "amplitude" a thousand times that in the other. In the case of applicant's invention, battery or direct current voltage is incidental and it is the structure of the tube which is fundamental.

An allowance is respectfully requested.

Respectfully,

HAROLD DeFOREST ARNOLD,

By [signature]

Attorney.

463 West Street,

New York, Feb 24, 1915.

-3-

1267

Div. 16 Room 109 2-200 Paper No. 9

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Mar. 10, 1915.

PATENT OFFICE
MAR 10-1915
MAILED

Mr. John G. Roberts,
463 West Street,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of
H. DeF. Arnold, S. No. 841,567, filed May 28, 1914.
Audions.

Thomas Ewing
Commissioner of Patents.

This action is in response to amendment filed Feb. 25, 1915.

In response to applicant's argument, it is noted that the amplitude of the variation of the current in the out-put circuit of an audion is produced by the audion, and the examiner does not deny that applicant can obtain a greater current amplitude variation by means of the improvements disclosed. The amount of current variation is, however, not dependent upon the voltage in the out-put circuit, but is caused by the variation in the impedance of the audion. Applicant's argument seems to be based on the ground that he obtains a greater current variation (line 4 from the bottom of page 3), rather than upon any improved voltage conditions. Claims 3, 4, 6 and 7, however, are drawn in terms of voltage characteristics and the examiner is still of the opinion that the out-put voltage depends upon the voltage of the battery in the out-put circuit.

In regard to claim 4, it is still thought to be obvious, especially in view of the disclosure in Schloe-

milch and Pierce, that the impedance drop between a cathode and anode of an audion varies with the distance therebetween and that to merely reduce the resistance to a point where the impedance is less than a certain amount does not amount to invention.

The fact that the characteristics of the audion can be predetermined adds no patentability whatsoever to the claims. Applicant might be able to mathematically calculate the characteristics of each audion in the art, but he could clearly not obtain a second patent on an old tube merely because he could determine its characteristics.

The claims should distinguish from the references by structural limitations. At present claims 3 and 4 do not distinguish in structure from the reference in any way. Claims 6 and 7 distinguish therefrom only in reciting that the in-put electrode is arranged closer to the cathode than to the anode. This alone is held not to be a patentable distinction.

Wm. A. Kinnan
Examiner, Division XVI.

005

Case 8

PAPER No. 10

AMENDMENT.

MAIL ROOM
SEP
22
1915

UNITED STATES PATENT OFFICE
Division 16 - Room 109

In re application of
Harold DeForest Arnold,
Serial No.841,567,
Filed May 28,1914

Audions

PATENT OFFICE
SEP 23 1915
DIV. 16 FILED

COMMISSIONER OF PATENTS,
Washington, D.C.

Sir:

Following the last Office action of March 10,1915 of this case, this specification has been rewritten with the object of making clearer the sense in which some of the terms are used and of exhibiting in quantitative form the relations which were merely described qualitatively in the original specification.

Please cancel the original specification and substitute therefor this one.

Claims 1, 2, 3 and 4 are those which have been allowed as Nos. 1, 2, 3 and 8 of the original specification, and in addition, claims 5 and 6 have been added which are now thought to be free from the objections made to claims 6 and 7 of the original specification.

REMARKS

The point of view of the Examiner, in arguing that the electromotive force of the output battery is one determining factor in the output voltage, is appreciated, and it has therefore been more specifically pointed out in the specification that

since it is the structure only which is the subject of the claims, only those changes in output voltage or current, which are due to changes in the structure itself, were in the mind of the inventor in this case. He is, of course, aware of the influence of battery voltage upon the characteristics of the device, having been, we believe, the first to make any scientific study of the audion amplifier. It is, however, impossible to secure the desired characteristics by a change in the single variable of battery, but the structure itself must be changed as described in this specification.

The terms "output voltage" and "output current" have been defined in the revised specification, these definitions indicating in precise form the sense in which these terms are understood and used in the art.

Respectfully,

HAROLD DeFOREST ARNOLD,

By J. H. Roberts

Attorney.

443 West Street,

New York, Sept 21, 1915

HDA-R

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PATENT OFF.
SEP 23 19
DIV. 16 FILED

MAIL ROOM
SEP.
22
1915
U.S. PATENT OFFICE

TO ALL WHOM IT MAY CONCERN:

Be it known that I, HAROLD DeFOREST ARNOLD, a citizen of the United States, residing at East Orange, in the County of Essex and State of New Jersey, have invented certain new and useful improvements in AUDIONS, of which the following is a full, clear, concise and exact description.

This invention relates to thermionic amplifiers of the audion type.

and its object is to provide a structure by which certain desired characteristics of the amplifier may be secured at will and in an efficient manner. This object is accomplished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in this specification.

In order that the novelty of this invention may be appreciated, and that those skilled in the art may be enabled to use this invention to best advantage, it is necessary that certain terms hereinafter used shall be defined. The following brief discussion is intended to explain the operation of the device and to define the terms to be employed.

The thermionic amplifier consists of a hot electron-emitting cathode, such as the so-called "Wehnelt" cathode, of a cool anode and of an auxiliary electrode called the grid, which is usually, though not always, located between the anode and the cathode. A battery is connected so as to force the electrons liberated at the cathode toward the anode, thus setting up a convection current carried by electrons in the evacuated space. In this specification, since the structure only is under discussion, only the effects of changes in the structure itself are considered. Obviously a change in the battery will also change the characteristic of the circuit, but in a way which is already known in the art. Due to the presence of these electrons, a negative space charge is established between the anode and the cathode, whose effect is to limit the number of electrons which can leave the cathode, and consequently to limit also the current which can flow in the output circuit, by which is meant the circuit including the battery and the path of the space current. The object of the grid is to furnish a means for introducing a further negative charge into the space between the anode and the cathode, or for introducing into it a positive charge which shall neutralize the effect of

part of the space charge due to the electrons. In the first case, the convection current is decreased; in the second it is increased. In order to force this charge to the grid, a source of electromotive force is connected between grid and cathode, that is, between the input terminals of the device. The effect of such an impressed electromotive force is therefore to alter the magnitude of the space current in the amplifier by changing the distribution of space charge between the electrodes, and moreover this is accomplished without requiring that the impressed electromotive force shall do more work than that involved in forcing the charge to the grid against the counter voltage of the condenser formed by grid and filament. Since in this operation the change in power consumed in the output circuit may be much greater than that required in charging the condenser, the device acts as an amplifier. This variation in space current, due to an impressed electromotive force, will hereafter be called the output current of the amplifier and the variation in voltage, which appears in the output circuit due to the impressed electromotive force, will be called the output voltage. The reason for adopting these definitions is that in the practical applications of the amplifier it is only these variations in current or voltage which are utilized; in fact, a transformer is ordinarily used to derive power from the output circuit, and obviously the steady space current or the steady output voltage have no effect in the secondary of that transformer and may be ignored for practical purposes. Thus, the term voltage amplification means here the ratio of the alternating voltage appearing in the secondary of such a unity ratio transformer to the alternating impressed voltage, when the transformer primary is made to include the whole of the output circuit external to the amplifier. In simpler terms, it is the ratio of the above defined output voltage to the impressed input voltage.

There will also be occasion to consider the ratio of

output current to input voltage, the latter being taken as standard throughout. When this ratio is high, other things being the same, the amplifier will be said to be of the high current type, and vice versa. This latter ratio is, of course, not a pure number, but is of the nature of an admittance.

It has been found that amplifiers may be designed to have predetermined values of these ratios. For example, one may be designed to deliver from its output circuit a comparatively high voltage with a low current, or vice versa. In the first of these two cases the output circuit would have a high alternating current impedance, and would therefore be adapted for use in connection with a high impedance circuit. For example, it could be used efficiently to work into the input circuit of another element, since that circuit has ordinarily a very high resistance. In the second of these cases the impedance of the output circuit would be lower and the amplifier would be suitable for use in connection with telephone lines, submarine cables, etc. In this connection it should be recalled that the maximum amount of power is transferred from one given circuit to another when the resistance of the second is made equal to that of the first.

Now, it has been found that for a given anode, cathode and output battery, the voltage amplification ratio depends upon the distance, d, from grid to anode, upon the internal resistance r of the amplifier, upon the external resistance R of the output circuit, and upon the character of the grid, all in the manner expressed by the formula:

$$\frac{d}{K}\cdot\frac{1}{1+\frac{r}{R}} \qquad (1)$$

in which K is a constant which depends upon the grid structure; in particular the number K is larger, the larger the ratio of open space in the grid to its conducting surface. It may be calculated

from the electrical and geometrical data of the system. The internal resistance r depends upon the areas and distance apart of anode and cathode, and, for the sake of efficiency, should be kept small by using a large cathode area, that is, a long filament, and by arranging the anode and cathode as close to one another as is consistent with conditions to be given later. It has also been found that this external resistance is proportional, for a given structure, to the square of the voltage amplification on open output circuit. Thus:

$$r \propto \left(\frac{d}{k}\right)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

From the formulae 1 and 2 follow the conditions to be satisfied in order that the amplifier may have given characteristics. Thus, if one of high voltage amplification is required, it will be necessary to make the distance from grid to plate large, the distance from grid to cathode small, the cathode area large and the mesh of the grid fine, that is, the ratio of open space to conductor area in the grid should be small. On the other hand, if it is desired to obtain a large current output, these formulae require that the distance from grid to plate shall be small, that that from grid to cathode shall be small, that the cathode area shall be large and that the mesh of the grid shall be coarse, that is, the grid should screen as little of the plate as possible when the latter is viewed from the cathode. Examination of these conditions shows that increasing the voltage amplification by adjusting the grid and plate decreases the current, and vice versa, so that the device acts in this respect much like an alternating current transformer. It has been found possible by using these relations to construct amplifiers which shall display characteristics which have been assigned beforehand.

The structural details of this invention will now be

more fully described in connection with the drawings in which Fig. 1 represents the structure of an amplifier having a high voltage amplification and a correspondingly low output current capacity; Fig. 2 is a plan view of the amplifier of Fig. 1 arranged to exhibit the geometrical configuration; Fig. 3 is a view of a structure designed to give a high output current; Fig. 4 is a plan view of the structure of Fig. 3; Figs. 5 and 6 are views corresponding to Figs. 3 and 4, respectively, of a modified structure of the aforementioned new type of amplifier. In these figures, like numerals represent corresponding parts.

Referring to Figs. 1 and 2, 1 represents the grid element, 2 the cathode or filament and 3 the anode or plate. The plate is placed a considerable distance from the cathode, and to make the distance $\frac{1}{2}$ from plate to grid as large as possible without at the same time increasing the resistance of the tube, the grid is placed as close as possible to the cathode, and it is preferably separated from the latter only by a thin insulating film which may be, for example, an oxidizing coating upon one or other of these elements. Further, as indicated by the structure of the formula 1, the grid is made to have a close mesh and thus to obstruct greatly the view of the plate as seen from the cathode. An amplifier, constructed as here illustrated, will have for a given input voltage a high output voltage and a low output current, these terms being interpreted as defined above. It will therefore be suitable for operation in connection with high impedance circuits.

Figs. 3 and 4 are two views of thermionic amplifiers of the high current type. In these structures, in conformity with the conditions already given, the distance from plate 3^a to grid 1^a is made as small as possible, as is also that from grid to filament 2^a. Further, the grid is made to have a coarse mesh, or is constructed so that the ratio of open space to the

projected area of the grid shall be large as required by the conditions explained for this type of amplifier. A particular amplifier, constructed in accordance with these specifications, has been observed to give an output voltage as here defined only one-third of the input voltage with a correspondingly high current, the effect being to make the apparent impedance of the output circuit as low as 500 ohms. This is in contrast to the high-voltage, low-current type which more closely resembles previously constructed amplifiers, and in which the voltage amplification is much greater than unity and the output impedance very large - so large that such an amplifier cannot be worked efficiently into an ordinary telephone line or similar circuit without the use of high ratio transformers.

Figs. 5 and 6 show another modification of the high current type of amplifier. In these figures the input electrode or grid is in the form of a wire P^b, bent back at its middle. In effect, therefore, the input electrode consists of two wires joined together. The filament F^b is wound about the input electrode and is insulated therefrom by a tube of insulating material 4, an arrangement which is not the invention of this applicant, but is described and claimed in a co-pending application in the name of Alexander McLean Nicolson, Serial No. 863,808, filed September 26, 1914 and assigned to the same assignee as the present application. The output electrode or anode consists of two plates S^a, S^a arranged upon opposite sides of the filament and close to it. It will be noted that the input electrode is not located between the filament and the plate, such not being necessary for efficient action in this high current type of amplifier. In all these amplifiers, the condition of most efficient operation requires that the resistance of the device shall be as small as possible and, consequently, irrespective of the distance of plate from cathode,

that the distance from grid to cathode shall be made as small as possible without encountering mechanical difficulties.

The novel features of this invention lie in so arranging the various elements as to secure this efficient action, while at the same time securing those voltage, current, and impedance characteristics which are desired.

WHAT IS CLAIMED IS:

1. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode in immediate proximity to said cathode but out of electrical contact therewith and closer to said cathode than to said output electrode.

2. A thermionic repeater having its cathode and its output electrode spaced apart a distance suitable for producing a desired ratio of output voltage to input voltage and having its input electrode as close as possible to said cathode without contacting therewith and closer to said cathode than to said output electrode.

3. A thermionic repeater having its output electrode arranged so close to its cathode as to develop output energy at a voltage lower than the voltage of the input energy and having its input electrode arranged closer to said cathode than to said output electrode.

4. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said input electrode being arranged much closer to said cathode than to said output electrode, and said output electrode and said cathode being so spaced apart and the amount of obstruction offered by said input electrode being such as to develop output energy at a voltage differing from the voltage of the input energy by a predetermined ratio.

5. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said input electrode being arranged closer to said cathode than to said output electrode, and

said output electrode and said cathode being so spaced apart as to secure a predetermined ratio of output voltage to input voltage of said repeater.

6. A thermionic repeater comprising an input electrode, an output electrode and a heated cathode, said input electrode being arranged closer to said cathode than to said output electrode, and the amount of obstruction offered by said input electrode being so low and the output electrode being arranged so close to said cathode as to produce a predetermined ratio of output voltage to input voltage of said repeater.

Insert 2a

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DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON Oct. 26, 1915.

Mr. John C. Roberts,
463 West St.,
New York, N. Y.

U. S. PATENT OFFICE
OCT 28 1915
MAILED

Please find below a communication from the EXAMINER in charge of the application of
H. DeF. Arnold, S. No. 841,867, filed May 28, 1914.
Audions.

Commissioner of Patents.

This action is in response to amendment filed Sept. 13, 1915.

The following reference is added to the record:

VonLieben et al, reissue 13,779, July 21, 1914, 179 - 171.

The new specification and claims have been substituted for the old.

Claims 3, 4, 5 and 6 are each rejected on the patent to vonLieben et al, above cited, which shows in Figure 1, for example, an input electrode H arranged much closer to the cathode K than to the output electrode A. These claims are therefore squarely met in structure and the function recited is insufficient to carry the claims for two reasons: first, it is a well settled rule that a claim to be allowable must distinguish from the prior art by structure and not merely by functional statements; secondly, it is thought to be old to operate a thermionic repeater with an output voltage, such as defined in the new specification, lower than the input voltage. In

this connection attention is directed to the specification of VonLieben et al, and particularly to the paragraph on page 2, beginning in line 41, in which it is stated that the variations of current and voltage in the output circuit are very low unless the voltage of the battery in the input circuit, the pressure of the gas in the tube, the temperature of the cathode, etc., are adjusted to the proper value. It appears to be clear that the repeater of VonLieben et al when adjusted so that the variations of current in the output circuit are small would produce an output voltage lower than the input voltage, the output voltage being defined as the variation in voltage in the output circuit, since the variation in voltage or potential difference across the secondary in the output circuit would be small when the variation of current in this circuit is small.

Claims 1 and 2 stand allowed.

Wm. A. Kinnan
Examiner, Division XVI.

CSS

Div. 14 Serial 109

"The Commissioner of Patents, Washington, D. C." and not any official by name.

Paper No. 12

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

Copy sent applicant and assignee.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON Oct. 14, 1916.

PATENT OFFICE
OCT 14 1916
MAILED

Mr. John C. Roberts,
465 West Street,
New York, N. Y.

Please find below a communication from the EXAMINER in charge of the application of

H. DeF. Arnold, S. No. 841,567, filed May 28, 1914,

Audions.

Thomas Ewing
Commissioner of Patents.

In view of an interference the following claims, readable upon Figures 5 and 6, are suggested to applicant:

An audion having input and output electrodes and a filament, one of said three members having the form of a helix and being located between the other two of said members.

An evacuated vessel containing three electrodes, one of which is a filament, one of said electrodes having the form of a helix and being located between the other two of said members.

An evacuated vessel containing three electrodes, one of which is a filament, one of said electrodes forming a hollow cylinder having for its area a discontinuous surface and containing within it one of the other two electrodes, the third electrode being located outside the cylindrical member.

A period of thirty days is granted applicant in which to overcome the Hull patent and present the above claims.

W.O.K.

Lucius F. Lewis
Asst Examiner, Division XVI.

1281

MAIL ROOM OCT 25 1916 U.S. PATENT OFFICE

PAPER No. 13
AMENDMENT 7

UNITED STATES PATENT OFFICE
DIVISION 16, Room 109

In re application of	
HAROLD DeFOREST ARNOLD	Audions
Serial No. 841,567	
Filed May 28, 1914	

PATENT OFFICE OCT 26 1916 DIV. 16

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

This amendment is in response to Office action of October 26, 1916.

Page 5, line 7, change "external" to --internal--; same page, line 29, after "transformer" insert the following:

--It is thus seen that the voltage amplification is directly proportional to the distance between the anode and the grid and that it is also proportional to the reciprocal of the constant K, as defined above. It is to be understood, however, that in using the term "directly proportional," it is not intended to imply that the proportion is mathematically exact, but that the term is used in contradistinction to, inversely proportional--.

Page 7, lines 21 and 22, cancel "a co-pending application in the name of", and substitute --patent 1,169,422, of January 25, 1916, to--. Cancel the remainder of the sentence commencing with "Serial No." in line 22.

Cancel claim 3, and substitute the following:

3 --A thermionic repeater having its output and input

(Serial No. 841,567)

--electrodes so spaced with respect to each other and to the cathode as to develop output energy at a voltage lower than the voltage of the input energy, but with a large current value--.

Add the following claims:

--7. A thermionic device for the amplification of electrical energies comprising a heated cathode and an anode, means for establishing an electric field between said cathode and anode whereby an electron stream is caused to flow therebetween, and an input electrode partially obstructing the passage of said electron stream, the degree of said obstruction being directly proportional to the preassigned voltage transformation component of said energy amplification.

8. In a thermionic device for the amplification of electrical energies, an input electrode comprising a conducting grid, the ratio of conducting surface to open space in said grid being directly proportional to the preassigned voltage transformation component of said energy amplification.

9. A thermionic device for the amplification of electrical energies comprising a cathode, an anode and a conducting grid, the ratio of conducting surface to open space in said grid and the distance between said anode and said grid being each directly proportional to the preassigned voltage transformation component of said energy amplification--.

(Serial No. 941,867)

REMARKS

Claims 3 to 6 have been rejected on patent to Von Lieben et al. It is true, as the Examiner states that Von Lieben shows a grid element which is located closer to the filament than to the anode, but it is respectfully urged that in doing so Von Lieben had no such conception regarding the value of so locating the grid or the value of changing its position, or of changing its anode, as has been disclosed in the invention of this applicant. It is true also that as Von Lieben points out his device may, under certain conditions, operate very inefficiently, in which case the output energy will be very low. It is to be observed, however, that when the output voltage decreases it is accompanied by a corresponding decrease in the output current. This, of course, is what will happen in any ordinary vacuum tube repeater, including the ones shown by applicant. As pointed out fully in his specification, the applicant has in mind a totally different effect, namely, that if the elements within the tube have a certain relative position with respect to each other, and that then certain changes are made in this relative position the voltage amplification for example will be increased, but in this case the current amplification will be decreased, or, on the other hand, if certain other changes are made the voltage amplification will be decreased, but the current amplification will be increased. In other words, it is not a question of the efficiency of operation of the tube, but rather the arrangement of the elements in such a manner that the tube will have these desired electrical characteristics

whereby it may be possible to construct a repeater which will be adapted for certain purposes.

With this in mind, the applicant has cancelled claim 3, and substituted therefor a claim which it is thought will bring out this feature by stating that when the voltage amplification is low the current will be large.

A reconsideration of claims 4, 5 and 6 in their present form is requested. In view of the fact that these claims state that the output voltage shall differ from the input voltage by a predetermined ratio, it is thought that the claims clearly distinguish from Von Lieben. No intimation whatsoever is contained in the Von Lieben specification which would teach any one that a tube could be constructed which would give a pre-determined ratio of output and input voltage. Von Lieben merely points out that it is disirable to maintain his grid at a certain voltage potential with respect to the filament in order to obtain reasonably efficient operation, and such an invention is not in any way connected, or associated, with the invention which the applicant has endeavored to set forth in these claims 4 to 6. This matter of pre-determining the ratio of the output and the input voltage is not merely a matter of mathematically calculating the characteristics of any audion in the art, but relates to, and, states the fact, that haveing previously determined what characteristics are desired in a repeater it is then possible by following certain rules, as laid down in this specification and claims, to construct a repeater which will have these desired or pre-determined characteristics. No information of such a character is even hinted at by

73/49

(Serial No. 841,567)

Von Lieben or the other references which have been made a part of this record.

In addition to the claims previously in the record, claims 7 to 9 have been added and it is thought that these claims are plainly allowable over the references cited.

Respectfully,

HAROLD DeFOREST ARNOLD

By J. G. Robertson
Attorney

463 West Street,

New York, Oct 24 1916

JO

78/50

MAIL ROOM NOV 13 1916 U.S. PATENT OFFICE

PAPER No. 14
AMENDMENT G

UNITED STATES PATENT OFFICE
Division 16 Room 109

In re application of
Harold DeForest Arnold
Serial No. 841,567
Filed May 28, 1914

Audions

PATENT OFFICE NOV 14 1916

COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

This amendment is in response to Office action of October 14, 1916.

Add the following claims:

3 ~~10.~~ An audion having input and output electrodes and a filament, one of said three members having the form of a helix and being located between the other two of said members.

4 ~~11.~~ An evacuated vessel containing three electrodes, one of which is a filament, one of said electrodes having the form of a helix and being located between the other two of said members.

5 ~~12.~~ An evacuated vessel containing three electrodes, one of which is a filament, one of said electrodes forming a hollow cylinder having for its area a discontinuous surface and containing within it one of the other two

(2)

Serial No. 841,549

electrodes, the third electrode being located outside the cylindrical member.--

REMARKS

The last sentence of the Office action relating to overcoming the Hull patent is not understood inasmuch as no Hull patent has been cited in this application. Further information is requested.

Respectfully,

HAROLD DeFOREST ARNOLD

By A. C. Rosenthal.
Attorney.

463 West Street,
New York, Nov. 11, 1916.

-2-

1291

INTERFERENCE. 13

Interference No. 40890 Paper No. 15

Name. H. W. F. Arnold

Serial No. 791,567

Title. Automobile

Filed, May 28, 1914

Interference with Davis v. Babcock & Wilcox et al & de Forest

DECISIONS OF

Primary Examiner, ... Dated, ...

Ex'r of Interferences, ... Dated, ...

Board, ... Dated, ...

Commissioner, ... Dated, ...

REMARKS:

Feb 23 1917 Reasons affidavit of Newberry and statement for Arnold

This should be placed in each application or patent involved in interference in addition to the interference letter by Primary Examiner.

12512

Forwarded from No. 16 to Division of Interference. 2-213 Paper No. 16.

Dec. 9, 1916. P.E. [illegible]

DEPARTMENT OF THE INTERIOR.

UNITED STATES PATENT OFFICE, A

WASHINGTON, D. C. "B"

Copy sent assignee.

U.S. PATENT OFFICE
INTERFERENCE ROOM
DEC 10 1916
MAILED

Mr. John G. Roberts,
485 Park Street,
New York, N. Y.

Please find below a copy of a communication from the Examiner concerning the application of H. DeF. Arnold, S. No. 841,567, filed May 28, 1914, Audions.

Very respectfully,

Room No. 109

ADDRESS ONLY THE COMMISSIONER OF PATENTS WASHINGTON, D. C.

40890

Commissioner of Patents.

The case, above referred to, is adjudged to interfere with others, hereafter specified, and the question of priority will be determined in conformity with the Rules.

The statement demanded by Rule 110 must be sealed up and filed on or before JAN 29 1917, with the *subject of the invention, and name of party filing it, indorsed on the envelope. The subject-matter involved in the interference is*

1. An audion having input and output electrodes and a filament, one of said three members having the form of a helix and being located between the other two of said members.

2. An evacuated vessel containing three electrodes, one of which is a filament, one of said electrodes having the form of a helix and being located between the other two of said members.

3. An evacuated vessel containing three electrodes, one of which is a filament, one of said electrodes forming a hollow cylinder having for its axes a circumferential surface and containing within it one of the other two electrodes, the third electrode being located outside the cylindrical member.

The interference involves your application above identified;

An application for Audions, filed by Lee deForest, 1391 Sedgewick Avenue, New York, N. Y., whose attorney is Philip Thurnworth, 149 Broadway, New York, N. Y.;

841,847 -- 2.

An application for Oscillation Responsive Device, filed by Otis B. Moorhead and Ralph C. Hyde, 1228 Myrtle St., Oakland, Calif., and 1719 Ninth St., Alameda, Calif., respectively, whose attorneys are White and Frost, Crocker Bldg., San Francisco, Calif.;

An application for Ionized-Chamber Devices, filed by Clifford D. Babcock, 19 East 18th St., New York, N. Y., whose attorney is Clair W. Fairbanks, 85 Liberty St., New York, N. Y., and whose assignee is John Neilsen, New York, N. Y., and

An application for Radio Detector, filed by Richard J. Davies, Jr., 334 4th Street, Weehawken, N. J., whose attorneys are E. E. Vrooman & Co., Warder Bldg., Washington, D. C.

The relation of the counts of the interference to the claims of the respective parties is as follows:

Counts:	Davies:	Babcock:	Moorhead:	deForest:	Arnold:
1	8	23	24	5	10
2	10	25	26	6	11
3	12	27	28	9	12

Examiner, Division XVI.

1291

Rev. 14. Room 113

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name.

E.R. S-sub

Paper No. 18

All communications regarding this application should give the serial number, date of filing, name of inventor, and name of the applicant.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON July 31, 1917.

U. S. PATENT OFFICE
JUL 31 1917
MAILED

John G. Roberts,
465 West St.,
New York, N.Y.

Please find below a communication from the EXAMINER in charge of this application of

Harold DeForest Arnold, S. No. 841,867, filed May 28, 1914, for Audions.

Thomas Ewing
Commissioner of Patents.

This case has been considered as amended Oct. 25, 1916 and Nov. 13, 1916.

As another application has been substituted for this application in Interference No. 40,880, claims 10, 11 and 12 should be canceled.

Claims 3 to 9 are rejected as unpatentable in view of the reissue patent No. 15,779, Von Leiben, of record. Claim 3 is also met by the audion disclosed on pages 64 and 65 of "The Wireless Telephone" of record. These references show the structure called for by the claims and the statement of function is considered insufficient to patentably distinguish from the references. Applicant's discovery appears to be the law governing the positioning of the elements for a desired output from the audion but that is no ground for the allowance of claims drawn to a structure that is now old in the art.

841.867 --2.

As this case has been pending for more than three years and the matter of these claims has been several times considered, this rejection is made final. The examiner will, however, admit any amendment that will put the case in condition for allowance.

Wm Akerman

Examiner, Division XVI.

1296

Case 8

APPLICATION FILED JUL 30 1918 U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 109 PAPER NO 19
AMENDMENT

In re application of

Harold DeForest Arnold

Serial No. 841,567

Filed May 28, 1914

Subject.

Auditions

JUL 31 1918

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of July 31, 1917.

Cancel claims 3 to 9 inclusive and renumber claims 10 to 12 inclusive as 3 to 5 inclusive.

REMARKS

The rejected claims have been cancelled.

A continuing application is being filed on this same date. The subject matter of the claims which are cancelled according to this amendment, is being presented in the continuing application, in new claims which it is believed are clearly allowable. Applicant desires it to be understood that he is not abandoning the subject matter of these claims, but is merely transferring it to the continuing application.

Respectfully,

HAROLD DeFOREST ARNOLD,

By A. G. Arnold
Attorney

463 West Street,

New York, July 24, 1918.

Div. 16 Room 112 C.N.D. 2-200

Paper No. 20.

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON August 29, 1918.

Mr. John G. Roberts,

463 West Street,

New York, New York.

AUG 29 1918

... and action in connection from the EXAMINER in charge of the application of

Harold de Forest Arnold, 841,567, filed May 28, 1914, for

Audions.

James T. Newton

Commissioner of Patents.

This action is in response to amendment of July 30, 1918.

In responding to the last office action no attention was paid to the requirement that claims 10, 11 and 12, now claims 3, 4 and 5, which have been inserted in another application, should be canceled from this application. The amendment, therefore, does not place this application in condition for allowance or appeal and the application is abandoned for failure to make a proper response within a year from the previous office action.

C. W. Hackett

Examiner, Division 16.

RWS

Recorded Vol. 128, p 154.

Harold DeF. Arnold.
No. 841,567.

24

The showing made is held to establish that the delay in the prosecution of the application was unavoidable within the meaning of Sec. 4894 R. S.
The petition is granted.

First Assistant Commissioner.

September 26, 1918.

1299

841,567—21.

Docket

SEP 5 1918

MAIL ROOM SEP 5 1918 U.S. PATENT OFFICE

Doc

UNITED STATES PATENT OFFICE

In re application of)
H. D. ARNOLD,)
Serial No. 841,567) Andions
Filed May 28, 1914)

PATENT OFFICE SEP-6-1918 DIV 14. FILED

PETITION.

TO THE COMMISSIONER OF PATENTS,

Washington, D. C.

Sir:

Your petitioner avers that he is the applicant above named, that the above entitled application was filed May 28, 1914 and has been diligently prosecuted since that time, that the Office action dated July 31, 1917 was received by him finally rejecting claims 3 to 9 inclusive and stating that claims 10, 11 and 12 should be canceled; that, as appears from an affidavit of Mr. C. A. Sprague accompanying this petition, an amendment in response to said Office action was prepared by his attorney and was filed in the United States Patent Office July 30, 1918; that it was the full intention of his attorney to comply with all the requirements of said Office action in every particular so as to place said application in condition for allowance; that such intention is evidenced by the entire tenor of said amendment as will be apparent from an inspection thereof; that by inadvertence no direction was given in said amendment to cancel claims 10, 11 and 12 which the Examiner stated "should be canceled", but instead it was directed that these claims be renumbered; and that said inadvertence was not noticed by his attorney until

1300

(Serial No. 841,567)

the receipt of the Office action of August 29, 1918 holding the application abandoned.

Therefore, your petitioner requests that said application be revived and that the accompanying amendment be entered therein to place said application in condition for allowance in accordance with the intent of applicant"s amendment of July 30, 1918.

Respectfully,

H. D. ARNOLD

By A. C. Hanner.
Attorney

463 West Street,
New York, September 4, 1918

CAS-PJ - 2 -

1301

Case 8

PAPER NO 2
AMENDMENT 1

MAIL ROOM
SEP
1918
U.S. PATENT OFFICE

UNITED STATES PATENT OFFICE.

Division 16 Room 112

In re application of

H. D. ARNOLD

Serial No. 841,567

Filed May 28, 1914

Subject.

AUDIONS.

PATENT OFFICE
SEP 6 - 1918

THE COMMISSIONER OF PATENTS,
Washington, D. C.

Sir:

In response to the Office action of August 29, 1918, cancel claims 3 to 5 inclusive, former claims 10 to 12 inclusive.

REMARKS

This action is taken to place this application in condition for allowance.

Through an inadvertence applicant failed to direct the cancellation of former claims 10 to 12 inclusive in the amendment of July 30, 1918. A petition is filed herewith setting forth this fact and accompanied by an affidavit and asking that this amendment be entered and the application allowed.

The requirements of the Office action of July 31, 1917 have now been fully complied with. The subject matter of this case is considered of such importance that a trip to Washington was made to insure that it receive proper attention. It is therefore hoped that the petition will be granted and the application passed for issue.

Respectfully,

H. D. ARNOLD,

By [signature]
Attorney

463 West Street,

New York, September 4, 1918

CAR-PJ

1302

MAIL ROOM SEP 5 1918 U.S. PATENT OFFICE

V. #21

UNITED STATES PATENT OFFICE

In re application of
H. D. ARNOLD
Serial No. 841,557
Filed May 28, 1914

Audions

AFFIDAVIT

I, C. A. SPRAGUE, being duly sworn, depose and say:

That I am employed by the Western Electric Company, Incorporated, as a patent attorney; that I was directed by Mr. D. C. Tanner, attorney of record in the above entitled application, to prepare an amendment in response to the Office action of July 31, 1917 in said application, placing the case in condition for allowance; that in accordance with said directions I supervised the preparation of the amendment filed July 30, 1918, said amendment being prepared with the full intention of completely responding to said Office action of July 31, 1917; that due to the importance of the subject matter of this application I was instructed by Mr. Tanner to make a trip to Washington to attend to this matter and to present this amendment for filing in the United States Patent Office; that I read the said amendment after its preparation but inadvertently failed to notice that it was not completely responsive to said Office action; that the fact that said amendment was not completely responsive was not called to my attention until the receipt of an Office action dated August 22, 1918, holding the case abandoned.

C. A. Sprague

Sworn to and subscribed before me
this 5th day of September, 1918.

Notary Public

1303

ABS. Paper No. 22.

DEPARTMENT OF THE INTERIOR.

UNITED STATES PATENT OFFICE.

Washington, Sept. 3, 1918.

In the application of
WARFOLD DeFOREST ARNOLD
Audions
Ser. No. 841,567
Filed May 28, 1914

ON PETITION
to the
COMMISSIONER OF PATENTS.

EXAMINER'S STATEMENT

This application was held abanddned as applicant in amendment of July 30, 1918 directed the cancelation of certain claims rejected in Office letter of July 31, 1918 but did not notice the requirement in the same Office letter that claims 10, 11 and 18, now claims 3, 4 and 5, be canceled. The cancelation of these claims was required as they has been inserted in another application for the purpose of an interference. The cancelation of these claims will place the case in condition for allowance.

Respectfully,

R.W. Smith

Acting Examiner, Division 16.

78/65

1304

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON

September 27, 1916.

In the matter of the Application of Harold Dolf. Arnold, Antigua; Filed May 26, 1914 Serial No. 841,867. } Petition to Revive.

Sir:

You are hereby informed that the decision of the First Assistant Commissioner on the above petition is as follows:

The showing made is held to establish that the delay in the prosecution of this application was unavoidable within the meaning of Sec. 4894 R. S.

The petition is granted.

R. F. Whitehead
First Assistant Commissioner.

September 26, 1916.

By direction of the Commissioner:

Very respectfully,

Chief Clerk.

Harold D-F. Arnold,
c/o John O. Roberts
120 Broadway
New York City.

73/66

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P.V.

Vol. III

175244
S.C.

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, [redacted] 1938

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
PETITIONER,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT

PETITION FOR CERTIORARI FILED MARCH 30, 1938.

CERTIORARI GRANTED OCTOBER 24, 1938.

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841,387	DeForest	Jan. 15, 1907	1424
879,532	DeForest	Feb. 18, 1908	1428
884,110	Stone, *et al.*	Apr. 7, 1908	1432
995,126	DeForest	June 13, 1911	1435
1,012,456	Seibt	Dec. 19, 1911	1438
1,038,910	Von Lieben, *et al.*	Sept. 17, 1912	1441
1,114,845	Arnold	Oct. 27, 1914	1446
1,127,371	Pierce	Feb. 2, 1915	1448
1,129,942	Arnold	Mar. 2, 1915	1453
1,129,943	Arnold	Mar. 2, 1915	1459
1,129,959	Colpitts	Mar. 2, 1915	1463
1,137,384	Colpitts	Apr. 27, 1915	1468
1,227,113	Campbell	May 22, 1917	1472
1,234,489	Reisz	July 24, 1917	1483
Re 14,380	Colpitts	Oct. 23, 1917	1486
1,257,381	Nichols	Feb. 26, 1918	1491
1,330,471	Kendall	Feb. 10, 1920	1497

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1,340,101	Alexanderson	May 11, 1920		1502
1,350,752	Van der Bijl	Aug. 24, 1920		1507
1,375,447	DeForest	Apr. 19, 1921		1514
1,377,405	DeForest	May 10, 1921		1523
1,384,108	Weagant	July 12, 1921		1528
1,388,450	Colpitts, *et al.*	Aug. 23, 1921		1531
1,393,369	Hewitt	Oct. 11, 1921		1537
1,398,665	Arnold	Nov. 29, 1921		1541
1,432,863	Johnson	Oct. 24, 1922		1546
1,448,550	Arnold	Mar. 13, 1923		640
1,558,436	Langmuir	Oct. 20, 1925		1550

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N—Copy of the curves, Fig. 27, p. of "Principles of Radio Communication" by J. H. Morecroft 583 1616

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3913

Defendant's Exhibit A.

GENERAL ELECTRIC-RADIO MAIN AGREEMENT

AGREEMENT made this 20th day of November, 1919, between GENERAL ELECTRIC COMPANY, a New York corporation, hereinafter called the General Company, and RADIO CORPORATION OF AMERICA, a Delaware corporation, hereafter referred to as the Radio Corporation.

3914

RECITALS.

A. The General Company has developed various inventions relating to, or applicable to, radio work and other communication work.

B. The General Company is under obligation to certain foreign companies to give them for their territory respectively exclusive rights to its various inventions and discoveries and to the business of selling General Electric products. Some of these companies are substantially controlled by the International General Electric Company, a New York corporation, hereinafter referred to as the International Company.

3915

C. The Radio Corporation proposes to establish, maintain and operate radio stations, and cable and wire lines and stations, and to deal in, lease and maintain radio devices, and desires to utilize in such work the various inventions now controlled by the General Company and which may hereafter be controlled by it.

3916 *Defendant's Exhibit A.*

ARTICLE I.

Definitions.

1. Radio purposes is defined as the transmission or reception of communications, telegraphic, telephonic, or other, by what are known as electromagnetic waves, but not by wire.

2. Radio devices are defined as comprising:

3917 (*a*) Devices useful only in radio purposes.

(*b*) Devices especially adapted to radio purposes but capable of other uses, such, for example, as the Alexanderson alternator with accessories or the pliotron, except where the same are sold licensed only for uses other than radio uses in which case the same are not to be regarded as radio devices hereunder.

3. The expression "devices" shall include ap-
3918 paratus, devices, systems, connections and methods.

ARTICLE II.

Licenses.

1. Reserving to itself and its controlled companies, present and future, respectively, personal licenses, transferable only to the successors to their business, or part thereof, and divisible only as their business is divided, to use for their own communication or other purposes for the convenience or to save expense, but not for

profit, the General Company hereby grants to the Radio Corporation an exclusive divisible license to use and sell as well as a non-exclusive indivisible license to make only when, and to the extent that, the General Company is not in a position to supply the desired device with reasonable business promptness (the right to use and sell being limited to the use and sale of apparatus purchased from the General Company or with its written consent, so far as the General Company is from time to time in condition to 3920
supply the same with reasonable business promptness) for radio purposes under all patents, applications for patents, inventions and rights or licenses under or in connection with patents which the General Company now owns or controls, or which it may acquire during the term hereof except those acquired by purchase and referred to below.

2. The General Company also grants to the Radio Corporation a non-exclusive non-transferable license to use, but not to make or sell 3921
(with the same limitations) for wire communication purposes under all patents, applications, inventions, rights and licenses which it now owns or controls or which it may acquire during the term hereof by inventions of its employees.

3. For the purposes hereof the inventions, patents and rights of the General Company are taken as including those of the International Company as well as following corporations, namely:

Australian General Electric Company,

3922 *Defendant's Exhibit A.*

China General Edison Company, Inc.,
Compania General Electric do Brazil,
South African General Electric Company, Ltd.,
Cia General Electric Sudamericana, Inc.,
Mexican General Electric Company.

4. The Radio Corporation grants to the General Company the exclusive, divisible right to make and sell radio devices to the Radio Corporation only as well as the exclusive divisible
3923 right to make, use and sell devices other than radio devices, under all its patents and applications for patents, inventions and rights or licenses under or in connection with patents which the Radio Corporation now owns or controls, or which it may acquire during the term hereof except as far as is provided below in the case of certain such acquired by purchase. The Radio Corporation grants the General Company and its controlled companies, present and future, non-exclusive licenses transferable only to successors to their business or parts thereof, di-
3924. visible only as their business is divided, to use for their own communication or other purposes for convenience or to save expense but not for profit under all the patents which the Radio Corporation now owns or controls or which it may acquire during the term hereof from the General Company or by inventions of its own employees or through contracts which it now has.

5. The said licenses are all to run for the terms for which the patents are or may be granted, re-issued or extended; and are subject to royalty only in so far as such royalties are payable to others by virtue of the contracts by

which the party granting the licenses acquired or shall acquire the right to grant the same, and only at a rate not greater than that paid by such party.

6. Where in any case a party does not own or control a patent but has lawful power to grant rights or licenses thereunder to the other for part or all of its field or territory it shall do so subject to the conditions hereof.

3926

7. In case the General Company shall acquire by purchase from others patents, patent applications, or rights or licenses under or in connection with patents, useful for or applicable to radio purposes or wire communication, and in case the Radio Corporation similarly acquires such patents, patent applications, or rights or licenses, the party making the acquisition will offer to the other to bring the same within the scope of this contract on payment of a fair proportion of the price actually paid or to be paid therefor. This shall not apply in the case 3927 of any patent, patent application, right or license secured by the Radio Corporation from or through the Marconi Wireless Telegraph Company of America, Marconi's Wireless Company, Limited, Compagnie Generale de Telegraphie sans Fils, or others with whom the Radio Corporation may have relations similar to its actual or proposed relations with any of said companies; all such are to be treated as though they were not acquired by purchase.

8. The General Company has sold its inventions for certain countries to companies other

than those mentioned in Section 3 of this article. All covenants of the General Company with respect to such countries are subject to the present rights of the companies holding such inventions. As such rights revert to the General Company they shall pass under the operation of this contract without further consideration.

9. Each company agrees to continue the present practice of the General Company of requir-
3929 ing those employees considered likely to make inventions along this line of work to assign inventions to it; it being understood that each company shall use its best efforts to carry out this provision, but if due care and diligence are exercised neither company shall be liable in damages for failure to carry it out.

10. As soon as is reasonably possible after the filing by or on behalf of a party hereto of a United States patent application, rights to or under which should pass to the other party, the
3930 party filing the application shall transmit a copy thereof to the other party with a statement of its filing date and shall notify the other party of the countries foreign to the United States in which it has decided to file and will file applications to cover the invention of such application. The other party may then suggest that applications should be filed in additional foreign countries in which the first party has the right to file. If and so far as the first party does not within thirty (30) days after such suggestion agree to file in such other foreign countries the other party may file proper applications for protecting such invention in such other for-

eign countries, and take patents thereon in its own name at its own expense. Before either party intentionally drops an application or patent of any country, rights to or under which should pass to the other hereunder, it shall notify the other party in which case such other party may continue the prosecution of the application or continue the life of the patent in question at its own expense, being entitled in such case to an assignment thereof.

3932

11. In case a right, application or patent is transferred by one party to the other in accordance with the provisions of Section 10 of this article, the party with which such right, application or patent organized shall be entitled to its full rights thereunder as though such patent had originated with and had been taken out by the other party subject to any royalty or other payment required to be made to an outsider in accordance with this agreement.

12. The admission of validity implied in the acceptance of licenses and assignments hereunder is limited to the field and terms for which such licenses exist. 3933

13. The General Company empowers the Radio Corporation to release the United States Government from any and all claims arising from past infringement by the Government of any radio patents which the General Company now owns or under which it has power to grant such release, provided that this can be done in a contract otherwise satisfactory to the General Company.

3934 *Defendant's Exhibit A.*

ARTICLE III.

Restrictions on Sales of Apparatus.

1. The General Company agrees that it will not sell or dispose of any radio devices whatever covered by patents, rights under which are granted or agreed to be granted herein, for use in the United States except to fill orders now on hand, and except to the United States Gov-
3935 ernment in cases where the Government insists on purchasing directly from the General Company (in which case the profits from such sales over the price of such devices to the Radio Corporation hereunder shall be paid to the Radio Corporation). The General Company further agrees that it will not sell or dispose of for use outside the United States any radio devices whatever covered by patents, rights under which are granted or agreed to be granted herein, except as it may be required to do so by existing contracts with others than the companies spe-
3936 cifically named in Section 3 of Article II hereof and except for its own use or for the use of the Radio Corporation. This reservation is not intended to enlarge the scope of the licenses granted in Article II hereof.

ARTICLE IV.

Sale of Apparatus.

1. The Radio Corporation agrees to purchase from the General Company all radio devices covered by patents, rights under which are granted or agreed to be granted herein, which

the General Company is from time to time in a position to supply with reasonable business promptness for use in, or which are used in, the business and operation of the Radio Corporation and its licensees and customers.

2. The General Company agrees to produce or cause to be produced such patented devices of good quality, workmanship, and material with reasonable business promptness on the written order of the Radio Corporation. 3938

3. The basis for determining the price charged by the General Company to the Radio Corporation shall be cost plus 20%, except that for all articles complete in themselves which are purchased by the General Company from outside manufacturers and which form a necessary part of the complete device supplied by the General Company, the price charged by the General Company to the Radio Corporation shall be cost plus 10% for handling charges.

4. The basis for determining cost shall be in accordance with the "Standard Accounting and Cost System for the Electrical Manufacturing Industry," as approved by the Federal Trade Commission, January 27, 1917. 3939

5. Terms of payment shall conform to the standard terms of the General Company current at the time of placing the order.

6. If the Radio Corporation in any particular instance wishes the General Company to make a definite and firm price for such radio devices,

and the General Company consents to make such firm price, such firm price upon acceptance by the Radio Corporation shall be substituted in such instance or instances for the cost plus 20% arrangement above mentioned.

7. All prices mentioned above shall be f. o. b. factory.

8. Standard material not specially designed for radio purposes is to be sold to the Radio
3941 Corporation at standard prices and on standard terms of payment but at the lowest price at which such standard material is sold in like quantities to any other customer of the General Company for use in the United States of America; and if at any time material, apparatus or supplies especially designed for radio purposes shall be sold by the General Company to its other customers for other uses than radio purposes in an amount greater than that taken by the Radio Corporation, the price at which such material, apparatus or supplies shall be
3942 sold to the Radio Corporation shall be the lowest price at which such material, apparatus or supplies are sold in like quantities to any other customer of the General Company for use in the United States of America. In determining such lowest price under this Section 8 no account shall be taken of sales:

(1) To those corporations in which the General Company may own a substantial amount of stock;

(2) Where the General Company sells material on a schedule, such material is to be billed to the Radio Corporation according to such schedule;

(3) Where the General Company has a lawful contract not to sell material below a certain price, such material is not to be billed to the Radio Corporation for a less price:

(4) To the United States Government or any of its departments.

9. It is agreed that the Radio Corporation shall not resell patented articles except as a part of the radio system. 3944

10. The Radio Corporation agrees not to lease, sell or dispose of devices bought of the General Company, where the General Company or one of the companies mentioned in Section 3 of Article II hereof would not be free to sell such devices. It being understood that the rights of the Radio Corporation are only for radio purposes as above defined, the Radio Corporation agrees to use care not to enter with any patented device, process or system into the field of the General Company or to encourage or aid 3945 others to do so, and specifically that in selling radio devices it will use such precautions by contract of sale, restricted license notices, etc., as may be necessary or advisable to prevent its customers from acquiring (by purchase from it of devices or otherwise) licenses to use the same for purposes of which the Radio Corporation has no right to grant such licenses. The General Company agrees to observe similar precautions in selling apparatus and devices especially adapted to radio work but capable of other uses.

11. The General Company agrees to sell the Radio Corporation such patented communication

devices as it may be in position to supply other than radio devices on the same terms, but only for the use of the Radio Corporation and not for resale or lease or other disposal and not exclusively.

ARTICLE V.

Alexanderson Alternator.

1. The Radio Corporation agrees to purchase
3947 from the General Company and the General Company agrees to sell and deliver f. o. b. factory to it, as fast as they can reasonably be constructed and prior to January 1, 1922, twelve (12) Alexanderson alternators complete with accessories, in accordance with specifications attached hereto and marked "Exhibit B" at the special price of one hundred twenty-seven thousand dollars ($127,000) apiece. Spare alternators or other incomplete spare equipments may be substituted at prices to be agreed upon provided that the total purchases hereunder aggregate in
3948 price the price of the twelve Alexanderson alternators with their accessories. In consideration for such agreement on the part of the General Company, the Radio Corporation agrees to issue and deliver to the General Company three hundred four thousand eight hundred (304,800) shares of its preferred stock, but subject to the provisions of Article VI hereof.

ARTICLE VI.

Sale of Materials.

1. The Radio Corporation proposes to purchase from the Marconi Wireless Telegraph

Company of America, hereinafter referred to as the Marconi Company, all of its property used or useful in connection with its manufacturing business, except the factory at Aldene, New Jersey. In case this purchase is made the Radio Corporation agrees forthwith to sell and does sell the property so purchased to the General Company, such sale to take effect immediately on the purchase of the same by the Radio Corporation, including all drawings, blueprints and material for manufacture and unfinished parts 3950
on hand or on order as of the date of the Radio Corporation's acquisition of the same, and any factory plants, tools, machinery and dies which it may acquire from the Marconi Company, but not including the publishing plant of the Wireless Press, Inc., nor the building and real estate at Seattle, Washington, which latter will no longer be used for factory purposes. The accounts receivable are to be collected and the accounts payable are to be paid by the Radio Corporation.

3951

2. The General Company agrees to pay for the property thus transferred by paying for the unfinished parts, work in progress and material on hand to be manufactured at actual cost of the same plus twenty per cent. (20%), which amount is to be ascertained by two appraisers, one appointed by the General Company and one appointed by Mr. Edward J. Nally. In case they disagree the matter shall be referred to Mr. S. Roger Mitchell, or other public accountant satisfactory to both parties, whose decision shall be final.

3952 *Defendant's Exhibit A.*

3. In case the Radio Corporation shall acquire, prior to January 1, 1922, the factory plants, lands, etc., of the Marconi Company, at Aldene, New Jersey, as set forth in Exhibit C hereto attached, it agrees forthwith to sell the same to the General Company and the General Company agrees to buy the same for five hundred thousand dollars ($500,000).

4. The payments by the General Company to
3953 the Radio Corporation under this Article and deliveries of preferred stock to the General Company in payment for Alexanderson alternators and their accessories in accordance with Article V hereof, are to proceed as follows: At the time of taking over the unfinished parts, work in progress and material on hand, a special account is to be set up between the General Company and the Radio Corporation, in which account is to be charged against the General Company the value of such unfinished parts, work in progress and material on hand, ascertained as above; if
3954 and when, prior to January 1, 1922, the Radio Corporation acquires the Aldene factory and transfers it to the General Company, its price five hundred thousand dollars ($500,000) is to be charged in the same account against the General Company. As and when the Alexanderson alternators and their accessories sold at the special price referred to above are shipped to the Radio Corporation, the price thereof is to be credited to the General Company on such account, until such credits aggregate one million five hundred twenty-four thousand dollars ($1,524,000). At any time when such account shows a balance in favor of the General Company the General Com-

pany may demand and shall then receive preferred stock of the Radio Corporation at par to any amount demanded not exceeding such credit balance, the par value of such stock to be charged to it in such special account and if at any time the balance of said account is in favor of the Radio Corporation, the General Company shall liquidate such balance by surrender to the Radio Corporation of preferred stock of the Radio Corporation of a par value equal to the amount of such balance. Such special account shall be 3956
entirely independent of all other accounts between the parties.

5. The Radio Corporation agrees to place forthwith with the General Company orders which will exhaust and consume said unfinished parts, work in progress and material; unfinished parts, work in progress and material not covered by such orders may be regarded by the appraisers as scrap in case the General Company shall find itself unable profitably to utilize the same. 3957

6. The General Company agrees to fill the orders so to be placed on it and to bill the same to the Radio Corporation; in making up price of the articles so billed in accordance with Article IV hereof, the price of the unfinished parts, work in progress and material taken over and inventories shall be taken as the price actually paid for the same by the General Company as above set forth, the additional work and material being charged on the basis of Article IV hereof.

ARTICLE VII.

EXPERT ADVICE AND TECHNICAL INFORMATION.

1. The General Company agrees that it will from time to time permit the Radio Corporation to have and will assist it in obtaining full information concerning inventions, patents and the patent situation of the General Company in the radio field. The Radio Corporation engages reciprocally to do the same for the General Com-
3959 pany.

2. The General Company agrees upon request to furnish the Radio Corporation suitable plants for buildings lay-out of machinery, antennae, etc., for use by the Radio Corporation hereunder, and if desired a man or men to supervise the construction and erection of such buildings, and the erection and installation of such machinery, etc., and also such other engineers and experienced men as the General Company can reasonably spare and the Radio Corporation may reasonably require in the organization,
3960 management and development of the business of the Radio Corporation, and to give the Radio Corporation and those whom the Radio Corporation may designate from time to time all information in regard to technical and engineering but not manufacturing matters which it may possess from time to time and which the Radio Corporation may reasonably require for the conduct of its radio business hereunder, and further agrees to assist the Radio Corporation in every reasonable way to the end that the Radio Corporation shall have whenever needed, in its operations hereunder, the benefits of the widespread experience of the General Company.

The Radio Corporation agrees to pay in each case the reasonable cost of furnishing such information and service, but not any part of the cost of acquiring the information except as the same may properly be charged as part of the development cost of apparatus which the General Company sells to the Radio Corporation.

3. Each party agrees to give the other at cost of supplying the same information and advice in connection with patent matters in its field.

3962

4. The Radio Corporation agrees to give full information to the General Company on the same terms, and further agrees to afford the engineering representatives of the General Company the fullest possible facilities, consistent with the reasonable operation of the Radio Corporation, for experimenting and for developing and testing new apparatus, devices and inventions.

ARTICLE VIII.

Term and Termination.

3963

1. This agreement shall continue until January 1, 1945, at which date it shall expire. As soon as is reasonably practicable after that licenses shall be granted as provided above under all patents to issue on patent applications which are then or may hereafter be filed in any country on inventions made or conceived by employees of either company up to the date of termination.

2. The Radio Corporation shall after January 1, 1945, be licensed under all patents referred to in this agreement so far as the General Company now has or may hereafter acquire the right to grant such license to the extent neces-

sary to enable it to manufacture for its own use hereunder, but not for lease, resale or other disposal, radio devices which it is unable to purchase of the General Company in accordance with the terms of Article IV hereof.

ARTICLE IX.

Further Assurances.

1. The parties agree to execute such further
3965 instruments as may reasonably be necessary for carrying out the purposes hereof.

ARTICLE X.

Controlled Companies.

1. This agreement shall be binding upon and inure to the benefit of the parties hereto and their successors and their controlled companies, present and future. The British Thomson-Houston Company, Limited and the Tokyo Electric Company, Limited, shall not for the purposes hereof be regarded as controlled companies of
3966 the General Company.

ARTICLE XI.

1. Inasmuch as the General Company is not willing to turn over its patents, patent rights and licenses for any definite sum of money, but is willing to transfer such patents, patent rights and licenses only for a considerable interest in the profits to be derived from the use by the Radio Corporation of such patents, patent rights and licenses, it is therefore understood and agreed that in the event of the taking over of the Radio Corporation by any superior authority all right, title and interest of the Radio Cor-

poration in any patent, patent right or license herein granted or agreed to be granted by the General Company to the Radio Corporation shall cease and shall be reassigned and shall revert to the General Company as of the date of such taking over except to the extent provided below. If instead of taking over the Radio Corporation the Government takes over its radio stations in any field and/or territory, except in and for time of war or public danger, the same result shall follow so far as concerns that field and/or 3968
territory. But this action shall in no way affect the rights of Marconi's Wireless Telegraph Company, Limited, or of Shielton, Limited, as set forth in the "Radio Corporation and British Marconi Company Principal Agreement", such rights shall be reserved from any such reassignment by the Radio Corporation for the benefit of Marconi's Wireless Telegraph Company.

IN TESTIMONY WHEREOF the parties hereto have caused these presents to be executed and their corporate seals to be hereunto affixed by their proper officers thereunto duly authorized at New 3969
York City the day and year first above written.

GENERAL ELECTRIC COMPANY,
By E. W. RICE, JR.,
President.

Attest:

J. W. ELWOOD,
Assistant Secretary.

RADIO CORPORATION OF AMERICA,
By FREDERICK C. BATES,
President.

Attest:

CHARLES H. WHEELER,
Secretary.

3970 *Defendant's Exhibit A.*

STATE OF NEW YORK, }
COUNTY OF NEW YORK, } ss.:

On this twentieth day of November, in the year one thousand nine hundred and nineteen, before me personally came Frederick C. Bates, to me known, who being by me duly sworn, did depose and say that he resides at Brooklyn, New York, that he is the President of the Radio Corporation of America, the corporation de-
3971 scribed in and which executed the above instrument, and also before me personally came Charles J. Wheeler, to me known, who, being by me duly sworn, did depose and say that he resides at Montclair, New Jersey; that he is the Secretary of the Radio Corporation of America, the corporation described in and which executed the above instrument; that he knows the seal of the said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed by order of the board of directors of the said corporation, and both the said
3972 Bates and the said Wheeler did depose and say that they had signed their names to the said instrument by order of the board of directors of the said corporation.

GERTRUDE CHANDLER,
Notary Public,
New York County No. 386,
New York County Register's No. 10324,
Commission Expires March 30, 1920.

Defendant's Exhibit A. 3973

STATE OF NEW YORK, }
COUNTY OF NEW YORK, } ss.:

On this twentieth day of November, in the year one thousand nine hundred and nineteen, before me personally came E. W. Rice, Jr., to me known, who, being by me duly sworn, did depose and say that he resides at Schenectady, New York; that he is the President of the General Electric Company, the corporation described in and which executed the above instrument, and 3974
also before me personally came J. W. Elwood, to me known, who, being by me duly sworn, did depose and say that he resides at Van Hornesville, New York; that he is the Assistant Secretary of the General Electric Company, the corporation described in and which executed the above instrument; that he knows the seal of the said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed by order of the board of directors of the said corporation, and both the said Rice and the said Elwood did depose and say that 3975
they had signed their names to the said instrument by order of the board of directors of the said corporation.

GERTRUDE CHANDLER,
Notary Public,
New York County No. 386,
New York Register's No. 10324,
Commission Expires March 30, 1920.

3976 *Defendant's Exhibit A.*

EXHIBIT B.

Item 1: 1-High frequency motor generator set consisting of:
1-600 H.P., 8-pole, quarter-phase, 2,200 volt, 900 r.pm. induction motor direct connected through a 3:1 gear to an alternator capable of generating directly frequencies up to 27,000 cycles.

Item 2: 1-High frequency transformer adapting
3977 the voltage of the alternator for the antenna.

Item 3: 1-Speed regulator for maintaining constant speed corresponding to wave lengths between 11,500 and 15,000 metres.

Item 4: 1-Magnetic amplifier for controlling the output of the alternator.

Item 5: 1-Switchboard for controlling the operation of driving motor and auxiliaries.

Item 6: 1-Operator's control board to control operation of the high frequency circuits.

Item 7: 1-Set of multiple tuning accessories for the antenna, equal in number to those now
3978 installed at New Brunswick, N. J.

Item 8: 1-3 Unit motor generator set consisting of a 440 volt, 3 phase induction motor, direct connected to a 15 Kw. 125-250 volt D. C. generator.

Item 9: 2-Motor driven water pumps providing circulating water for alternator bearings and armature.

Item 10: Full set of instructions and drawings suitable for installation and operation purposes.

The Company proposes to furnish apparatus and devices for a complete, continuous-wave

radio transmitting system for hand key operation, exclusive of building, foundations, towers for antenna, water and power supply.

The items enumerated above constitute the principal features of this system.

Multiple tuning of the antenna increases the efficiency of radiation. The Company's guarantee as to operation is based on this fact and the use of the multiple tuned antenna. Item No. 7 covers apparatus that will be used to accomplish multiple tuning. The equipment may be 3980
used without multiple tuning, but when so used the efficiency of the system will be decreased.

The motor and gear are designed for a maximum speed corresponding to a wave length of 11,500 metres and variable speed control is provided for operation at longer waves. The system to be furnished is designed to operate at wave lengths between 11,500 metres and 15,000 metres and is guaranteed, when used with multiple tuned antenna, to produce a charging current of 400 amperes at 12,000 metres in an antenna of the New Brunswick, New Jersey, type. 3981
The antenna charging current is to be measured when the key is pressed and the equipment shall be capable of operating continuously for a period of twenty-four consecutive hours with telegraph control.

EXHIBIT C.

The land and real estate now owned by the Marconi Company at Aldene, in the State of New Jersey, together with the factory buildings, wireless towers and structures located on such land, the said land being located between the

3982 *Defendant's Exhibit B.*

fork of the Lehigh Valley Railroad and the Central Railroad of New Jersey on the east and bounded on the north by Westfield Avenue, together with the tools and machines in all such structures.

Defendant's Exhibit B.

3983

LICENSE AGREEMENT

GENERAL ELECTRIC COMPANY
AND
AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

July 1, 1920

AGREEMENT made this first day of July, 1920, between the GENERAL ELECTRIC COMPANY, a New York corporation (herein called the General
3984 Company), and the AMERICAN TELEPHONE & TELEGRAPH COMPANY, a New York corporation, herein called the Telephone Company

WHEREAS, the General Company is engaged in the manufacture and sale in the United States of apparatus and systems for the generation, distribution and utilization of electricity for light, heat, power, traction and associated purposes; and in the manufacture and sale of a general line of electrical and power apparatus, machines and appliances, and, directly and through affiliated companies, is engaged in the purchase of apparatus and devices of various kinds from

others and in the sale thereof; and is also engaged in the manufacture and sale of wireless apparatus and appliances; and

WHEREAS, the Telephone Company and its Associated Companies are engaged in the operation of telephone and telegraph systems; and

WHEREAS, each party is in possession of information, patents and inventions applicable to, and has research organizations engaged in investigations bearing upon, not only its own business but also the business of the other party; and 3986

WHEREAS, various patents or applications for patents of the parties are involved in interference with each other in the United States Patent Office; and

WHEREAS, the restrictions upon each party imposed by the patent rights of the other and the uncertainties arising out of interferences have tended to, and if permitted to continue will, hamper and delay progress in the development and production of wire and wireless telephone and telegraph apparatus and systems; and 3987

WHEREAS, the effective and prompt development of the arts in question can be secured only by the free and frank cooperation and exchange of information between the parties, which cannot well take place if improvements and knowledge resulting from one party's cooperation with the other party, may without its consent be made available in its field to the use of others.

3988 *Defendant's Exhibit B.*

Now, in consideration of the premises and the mutual agreements herein continued, it is agreed as follows:

ARTICLE I.

Definitions.

For the purposes of this agreement the following terms are defined as follows:

3989 "Wire Telephony" is the art of communicating on reproducing sound waves. (created, directly or indirectly, by the voice or by musical instruments) by means of electricity, magnetism or electro-magnetic waves, variations or impulses conveyed or guided by wires, and includes all generating, measuring, switching, signaling and other means or methods incidental to or involved, in such communication.

3990 "Wireless Telephony" is to be taken as meaning the same as the above, except that the waves, variations or impulses are radiated through space.

"Wire Telegraphy" is the art of communicating messages by code signals (such as the Morse Code, for example) by means of electricity, magnetism or electro-magnetic waves, variations or impulses conveyed or guided by wires, and includes all generating, measuring, switching signaling and other means or methods, incidental to or involved in such communication, but does not include such devices as annunciators, elevator signals, engine room telegraphs, etc.

"WIRELESS TELEGRAPHY" is to be taken as meaning the same as "wire telegraphy," except that the waves, variations or impulses are radiated through space.

"POWER PURPOSES" are defined as including all prime movers and their accessories and all generation, use, measurement, control and application of electricity for light, heat and power, but does not include any communication purposes. 3992

"HOUSEHOLD DEVICES" are electric or electrically operated devices designed primarily for domestic use, but do not include devices for communication purposes.

"TRANSOCEANIC" communication shall be understood to include all communication between two continents, or between a continent and an island more than one hundred miles from its shores; islands within one hundred miles of the shores of a continent being considered parts 3993 thereof. North America, including the Panama Canal Zone and all of Central America north thereof, is to be considered as one continent, and South America and all of Central America south of the Panama Canal Zone as another. This definition does not include communication between ships or between ships and shore.

"THE UNITED STATES GOVERNMENT" shall be understood to include not only the Federal Government but also the Governments of the Philippines, Porto Rico and other federal possessions, present or future; but shall not include any municipal, county or state government.

3994 *Defendant's Exhibit B.*

"TRAIN DISPATCHING" is telegraphic or telephonic conveyance of train orders or operating information between the office of a train dispatcher or similar official and way stations, or other points along the line of way, or railway vehicles (with or without incidental provision for operating at will in an emergency, and not automatically, signals, brakes, stops and switches) for controlling the movements of trains or other automotive vehicles.

3995 "RAILWAY SIGNALLING" is the operation of signals, switches, brakes, stops, etc., controlling the movements of trains or other automotive vehicles, controlled by or in accordance with train or vehicle movements or track conditions, including block signalling, cab signals and train stops. It does not include train dispatching as above defined.

Any question arising as to the meaning or application of the foregoing definitions shall be settled by arbitration, as hereinafter provided.

3996 ARTICLE II.

THE PATENTS INCLUDED IN THIS AGREEMENT.

The licenses provided for herein, are granted and agreed to be granted under all patents, and rights to or under patents, of the United States now or hereafter during the term of this agreement owned or controlled by the parties hereto, and under all such patents hereafter issued upon inventions now or hereafter during said term so owned or controlled, and to the extent to which the parties have or may have the right to grant licenses, EXCEPTING as otherwise speci-

fied in connection with the several grants hereinafter contained, and EXCEPTING such patents and inventions as may be excluded from the operation of this agreement in the following manner.

A list of all United States patents under which it now holds transferable rights shall be furnished by each party to the other within sixty days from the date of this agreement. Such lists shall separately identify those patents, and shall also include those applications, as to which rights, 3998
if granted hereunder, would be restricted in scope or would involve continuing obligations not implied by law. Copies of all contracts creating such restrictions or obligations shall, upon request, be furnished by each party to the other. Thereupon, and within six months after the receipt of the lists to be furnished as aforesaid, each party may in writing advise the other as to the patents and applications described in such list, furnished by the other, which (or the patents to issue on which) it desires to exclude from this agreement; and no licenses are granted by 3999
this agreement under any patents so excluded. Each party shall thereafter, at such periods as may be agreed upon, or whenever requested by the other party, furnish to such other party like lists of subsequent patents and applications, and upon request therefor like copies of contracts; and each party may, within six months after the receipt of any such list, advise the other in writing as to the patents and applications described in such list which (or the patents to issue on which) it desires to exclude from this agreement; and no licenses are granted by this agreement under any patents so excluded.

4000 *Defendant's Exhibit B.*

ARTICLE III.

Scope of Licenses.

All of the licenses herein granted are, unless otherwise expressed in connection with the several grants, licenses to use methods and processes, and to make, use, lease, sell or otherwise dispose of apparatus, machines, devices, appliances and systems embodying the inventions of
4001 the several patents, in the fields in which the licenses are granted.

But no rights are granted to either party to manufacture, or to have manufactured, under patents under which it receives licenses hereunder, apparatus of the character at the time manufactured by the other party, except in factories owned or operated by one or the other of the parties hereto, or by their controlled companies, without the written consent of the party granting such licenses.

4002 ## ARTICLE IV.

Reservations and Exceptions to Which the Licenses Are Subject.

1. Each party reserves a non-exclusive right, under its own patents, to manufacture for and sell to the United States Government wireless devices, apparatus and systems, and to grant to that Government non-exclusive licenses to make or have made for it any wireless devices, apparatus and systems; but such devices, apparatus and systems are licensed to be sold to the Government only for governmental and not for

commercial uses or for toll, and not for resale, and the non-exclusive licenses which may be granted to the Government shall similarly be limited.

2. Each party reserves, under its own patents, rights in the fields and for the uses with reference to which it receives licenses under patents of the other party.

3. No licenses are granted by either party with reference to the manufacture and sale of wire or cable for the transmission of electric power or telephone currents. 4004

4. No licenses are granted to the Telephone Company for electric lamps or other lighting devices (except non-exclusive licenses with reference to telephone and telegraph switchboard signal lamps and ballast lamps), nor for the working of tungsten. But the Telephone Company is licensed to use, in the fields for which it receives licenses hereunder, tungsten purchased from the General Company, or from others having the right to make and sell tungsten, and to make, use, sell or lease (for such fields only) devices embodying such tungsten. The General Company agrees to sell and deliver such tungsten for such purposes, in wire or other practicable form to be specified by the purchaser from time to time, on the terms specified in Article X hereof. 4005

The Telephone Company agrees that, on all sales of telephone and telegraph switchboard lamps or ballast lamps, hereunder, to others than the Associated Companies of the Bell System,

it will pay to the General Company a royalty of 2% on the net sales price thereof.

5. The licenses hereinafter granted to the Telephone Company, in so far as they cover rights to sell or lease "carrier current," wireless or vacuum tube devices for use on electric railroads, are limited to the sales or leases of said devices to the railroads; all sales of such devices to be installed on electric cars or electric
4007 locomotives, as a part of the original construction and equipment thereof, shall be through the General Company only.

ARTICLE V.

Licenses Granted.

Subject to the foregoing reservations, each party grants and agrees to grant to th other the following licenses in the following fields of use:

4008 1. *Government Uses.*

Each party grants to the other non-exclusive licenses, to which all exclusive licenses herein granted are subject, to make any and all wireless apparatus and systems for and to sell the same to the United States Government, but only for governmental and not for commercial or toll uses and not for resale.

2. *Wireless Telegraphy.*

(*a*) The General Company grants to the Telephone Company non-exclusive licenses in the

field of wireless telegraphy for its own communication or for purposes of convenience or to save expense in connection with its commercial operation of wire telegraph and wire and wireless telephone systems, but not for profit or for transmission of messages for the public.

(*b*) Subject to the foregoing, the Telephone Company grants to the General Company exclusive licenses in the field of wireless telegraphy. 4010

3. *Wire Telegraphy.*

(*a*) The Telephone Company grants to the General Company non-exclusive licenses to make for its own operation and to operate wire telegraph systems, other than trans-oceanic; but no licenses are granted with reference to operation on lines leased to others than parties hereto or their subsidiary companies to which rights hereunder may be extended in accordance with subdivisions (*b*) of Section 3 of Article VI; and no licenses are granted with reference to trans-oceanic wire telegraphy. 4011

(*b*) Subject to the foregoing, the General Company grants to the Telephone Company exclusive licenses in the field of wire telegraphy on land, and over ocean cables not more than one hundred miles in length, and between the main body of the United States and Cuba; but no licenses are granted with reference to other trans-oceanic wire telegraphy.

4012 *Defendant's Exhibit B.*

4. *Wireless Telephony.*

(*a*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wireless telephony for its own communication or for purposes of convenience, or to save expense in connection with its commercial operation of wireless telegraph systems, but not for profit or for transmission of messages for the public.

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(*b*) The Telephone Company grants to the General Company licenses (exclusive, except that the Telephone Company reserves exclusive rights for the uses and to the extent specified in subdivision *c* of this Section 4) in the field of trans-oceanic wireless telephony, such licenses being limited, so far as concerns service on this continent for the public or for others than the General Company, to rendering such service through only the Telephone Company's wire or wireless telephone systems, such limitation
4014 to exist so long as the Telephone Company remains in a position to and does supply that service. The General Company is, however, licensed to bring trans-oceanic wireless telephone messages by wire telephony to, and transmit them from a central or transfer point at a distance from its wireless stations (one such point for each pair of trans-oceanic stations) and the Telephone Company agrees that at such point it will establish communication with its system, but the Telephone Company shall not be required to accept any such point more than five miles from the nearest telephone central exchange of the Bell system. All service for the

public shall be through the Telephone Company's system, and shall be advertised as service of the Telephone Company through stations of the General Company when and so long as the General Company maintains facilities for the trans-oceanic wireless telephone service.

Joint through rates and the division of rates shall be agreed upon, it being agreed in principle that the General Company is entitled to its reasonable tolls between the central or transfer point and the distant country (including the 4016
amount, if any, paid to the foreign company with which communication is had), and that the Telephone Company is entitled to its reasonable tolls between the central or transfer point and the destination or sending point in the United States.

(*c*) The General Company grants to the Telephone Company licenses (exclusive, except that the General Company reserves exclusive rights for the uses and to the extent specified in foregoing subdivision *b*) in the field of trans-oceanic wireless telephony, such licenses being limited, 4017
so far as concerns service, for the public or for others than the Telephone Company, to rendering such service through only the General Company's systems for trans-oceanic communication. But if and so long as the General Company is not prepared to and does not remain in a position to and does not supply such service, the Telephone Company may establish wireless stations for rendering such service, after giving the General Company reasonable notice and opportunity to do so, and shall have the right to continue to render such service through all such stations established by it except in so far as the

General Company shall elect to co-operate in rendering such service, or any portion thereof, in which event the General Company shall take over those stations, or such of them as it shall elect, at the then cost of reproduction less depreciation. While the trans-oceanic service is being rendered through the General Company's stations, the advertising and the division of rates shall be as provided in foregoing subdivision *b* of this Section 4.

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(*d*) The Telephone Company grants to the General Company

(1) Exclusive licenses to make, use, lease and sell wireless telephone apparatus and systems for communication by and between airplanes, airships, ships and other automotive devices, except railway vehicles. The General Company is granted non-exclusive licenses to establish transmitting and receiving stations for communication with the

4020 foregoing, but is given no right to connect with any public service telephone system. The Telephone Company is licensed, but is under no obligation, to establish or maintain means by which such wireless telephone communication may be had with and through the Telephone Company's telephone system, and the Telephone Company is under no obligation to permit such communication. If, however, the Telephone Company shall establish, maintain or permit such wireless telephone communication through stations of third parties, other than the United States Government, it shall do the same with

respect to the General Company's stations on at least as favorable terms, including distribution of tolls, and engineering requirements. In case, at any time, the General Company has established such a station as is referred to in this paragraph, and the Telephone Company shall elect to co-operate or render such wireless service in any substantial part of the same territory, it shall purchase the said station of the General Company at the then cost of reproduction 4022
less depreciation.

(2) Non-exclusive licenses to establish and maintain transmitting stations for transmitting or broadcasting news, music and entertainment from a transmitting station to outlying points, and licenses to make, use, sell and lease wireless telephone receiving apparatus for the reception of such news, music and entertainment so broadcasted. For the protection of the General Company under the license which it receives in this para- 4023
graph, it is agreed that the Telephone Company has no license under this agreement to make, lease or sell wireless telephone receiving apparatus except as part or for direct use in connection with transmitting apparatus made by it; and for the protection of the Telephone Company under the licenses hereinbelow granted to it, it is agreed that the General Company has no license to equip wireless telephone receiving apparatus sold under this paragraph with transmitting apparatus, or to sell, lease or otherwise dispose of transmitting apparatus for use in

connection with receiving apparatus sold under this paragraph.

(3) Exclusive license to make, use, lease and sell all wireless telephone apparatus for amateur purposes.

(4) Exclusive licenses to make, use, lease and sell all wireless telephone apparatus (but not for public service) where the business use thereof is incidental (as for example for farmers), or where at least one of the stations is portable and is intended to be moved from place to place (as for example in lumbering operations) or where such wireless apparatus brings communication to new points not at the time served by the Telephone Company.

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(5) Reserving to itself all exclusive license to make, use, sell and lease all wireless telephone apparatus to electric light, electric power and electric traction companies for connection with wire or wireless public service telephone communication systems and receiving from the General Company a similar exclusive license of the same scope under the General Company's patents, the Telephone Company grants to the General Company exclusive licenses to make, use, sell and lease all wireless telephone apparatus for electric light, electric power and electric traction companies but only for the use of such companies and not for the use of the public, nor for toll, nor for the operation of a selective train dispatching system

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and not for connection with any public service telephone system.

(*e*) The General Company grants to the Telephone Company:

(1) subject only to subdivisions (*a*), (*b*) and (*c*) and paragraph (1) of subdivision (*d*) of this Section, exclusive licenses in the field of wireless telephony to make, use, lease and sell all wireless telephone apparatus connected to or operated as a part of a public service telephone communication system, whether wire or wireless. 4028

(2) subject to all of the foregoing, exclusive licenses in the field of wireless telephony to make, use and sell for all business, public service and commercial uses of such character as might be served by leased wires, as for example brokers' offices, business houses, manufacturing plants, gas and water companies, mining companies, etc. 4029

(*f*) It is further agreed that in the fields of the exclusive licenses granted by paragraphs (3), (4) and (5) of Section (*d*) above and in paragraph (2) of Section (*e*) above, and for any wireless telephone uses not specified herein, each party will on application of the other party grant a license to the other party on reasonable terms for each specific installation for which such other party desires to manufacture and dispose of such wireless telephone apparatus; the license fee to be fixed with due regard to the benefits derived by the licensee and the disadvantages suffered by the licensor in the granting of such license.

5. *Wire Telephony.*

(*a*) The Telephone Company grants to the General Company licenses (exclusive, except that the Telephone Company reserves non-exclusive rights) to make and sell (but not to lease) to electric light, electric power and electric traction companies apparatus for so-called "carrier current" telephone communication over wires, or partly over wires and partly across wireless gaps, but in each instance only for the
4031 use of such companies and not for the use of the public, nor for toll, nor for operations of a selective train dispatching system, and not for connection with any public service telephone system.

(*b*) Subject to the foregoing, the General Company grants to the Telephone Company exclusive licenses in the field of wire telephony on land, and over cables not more than one hundred miles in length, and between the main body of the United States and Cuba; licenses are granted by
4032 each party to the other with reference to the other trans-oceanic wire telephony, such licenses being of the character and subject to the limitations and provisions expressed in foregoing subdivisions (*b*) and (*c*) of Section 4, with reference to trans-oceanic wireless telephony.

6. *Power Purposes and Household Devices.*

The Telephone Company grants to the General Company exclusive licenses in the fields of power purposes, household devices, and distance actuation and control by wireless for other than communication purposes. This grant is made with a reservation in so far as concerns patents

for inventions relating to business of the general character which any controlled Company of the Telephone Company now conducts as jobber, and any extensions of that business along similar lines. With reference to such patents (except those covering articles of the general character which such Company now purchases from the General Company, or its affiliated companies, or sells as agent for the same), the Telephone Company reserves under its own patents (but is granted no license under the patents of the 4034
General Company) the non-exclusive right for such controlled companies to make apparatus and devices embodying the inventions of said patents, or have them made for them, and to sell them in the said jobbing business.

7. *Railroad Signalling, X-ray Devices, Radio Goniometry.*

The Telephone Company grants to the General Company exclusive licenses in the fields of railroad signalling (other than train dispatching), X-ray devices and appliances associated 4035
therewith, and radio goniometry.

8. *Train Dispatching.*

Subject to the foregoing, the General Company grants to the Telephone Company exclusive licenses in the field of train dispatching.

9. *Submarine Signalling, Scientific Therapeutic Apparatus, Shop Expedients and Other Applications.*

Each party grants to the other, non-exclusive, licenses in the following fields:

Submarine signalling.

Scientific apparatus for use of laboratories, colleges and scientific societies, as distinguished from commercial use.

Wireless apparatus for use of professional investigators (as distinguished from amateurs) for experimental purposes only.

Therapeutic apparatus other than X-ray devices and appliances.

Shop tools, appliances and processes, but only for the production of apparatus and devices embodying inventions which the grantee is licensed to make and use hereunder.

All applications, not herein otherwise specified, of inventions pertaining or applicable to or to the use of vacuum tubes, and to generating (directly or from other currents), modifying, amplifying, transmitting or receiving electro-magnetic waves, variations or impulses for other than power purposes, including instruments and their records for producing music and other sounds for amusement or artistic purposes, with the right to transmit the sound by wire telephony throughout a building.

ARTICLE VI.

Provisions with Reference to Foregoing Licenses.

1. Whenever licenses granted under the terms of this agreement are based upon rights requiring the payment of royalties or other deferred payments, measured by the use made of the invention, the party accepting such licenses shall

make payments measured by its use of the invention at the same rate and upon the same terms as those agreed to be made by the party originally acquiring the rights.

2. The foregoing licenses shall continue respectively for the terms of the several patents issued or to be issued under which they are granted and agreed to be granted, and shall not be limited by the term of this agreement.

3. (*a*) The Telephone Company may grant sublicenses under its standard form of license contract (a copy of which is now delivered to the General Company) to such operating companies as are now or may from time to time be operating under such form of contract. The provisions of this subdivision (*a*) shall apply to any changed form of license contract provided that, as changed, it grants rights in the fields of the General Company no broader than those granted by the present form.

(*b*) Subject to the foregoing sub-divisions (*a*), each party hereto may assign or grant sub-licenses under any of the rights granted hereunder, provided that in each instance the assent of the other party is first obtained.

(*c*) No disposition by either party of rights hereunder acquired by it, shall relieve such party of any of its obligations under this agreement, or restrict the rights of the parties hereto in operating under or modifying this agreement.

4. Each party agrees that, so far as it is enabled so to do, it will in disposing of devices embodying inventions pertaining or applicable to

vacuum tubes, or to generating, modifying, amplifying, transmitting or receiving electro-magnetic waves, or other devices or material the unrestricted sale of which would deprive the other party of rights to which it is entitled hereunder, use such precautions by contracts, restricted licenses or otherwise as may be necessary or advisable in order to prevent its customers or others from acquiring (by acquisition of devices from it or otherwise) licenses to use
4043 the same which the party disposing thereof has no right to grant.

5. The admission of validity implied in the acceptance of licenses hereunder is limited to the field for which such licenses exist.

6. One or the other of the parties hereto having already parted with rights under its inventions, present and future, in most of the foreign countries, it is agreed that the parties will co-operate with each other and with their foreign affiliated companies who may desire li-
4044 censes under the inventions of the other party, to the end that exchanges of licenses, may be effected in such countries. No licenses under foreign patents are now granted or are to be implied; but the licenses herein granted under United States patents include the right to manufacture and sell for uses abroad. Each party agrees not to export to any country in which the other party has an affiliated company, apparatus purchased from such other party which such other party could not itself so export, in view of existing contract obligations, after notice of such obligations and without first securing a written waiver thereof.

7. Each party represents that in its best judgment it has no outstanding obligations which would prevent it from entering into the agreements and from granting the licenses herein expressed. If, however, it is found that there are such conflicting obligations, the present agreement is made subject to the right to fulfil those obligations.

ARTICLE VII. 4046

Interferences.

The parties agree to use reasonable endeavors to settle, without litigation, interferences now pending or which may arise involving inventions within the scope of this agreement.

ARTICLE VIII.

Acquisition of Patent Rights.

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Neither party shall acquire from others rights to or under United States patents or inventions, or rights to use secret processes, applicable to the fields of the other party, of such limited character that the other party does not, by the operation of this agreement, receive licenses thereunder of the scope and within the respective fields herein set forth, unless the party proposing to acquire such rights shall first have given the other party an opportunity to be represented in the negotiations and thereby to acquire rights for its field.

ARTICLE IX.

Co-Operation and Exchange of Information.

1. Each party agrees that it will, from time to time during the term of this agreement, freely permit the other to have all information in its possession which it may have a right to disclose with reference to devices, apparatus, systems or methods applicable to the uses of the other party as herein defined, it being agreed that any
4049 secret process so disclosed shall be maintained in secrecy by the party to whom it is disclosed. Blue prints, etc., shall be furnished at the cost of preparing the same. Each party shall at all reasonable times have access (through a reasonably limited number of accredited representatives who are regular employees under obligation to assign inventions to their employer), to the laboratories, factories and wireless stations of the other, to the end that development work may be expedited and rendered the more effective.

4050 Each party shall, with reference to inventions owned or controlled by it and under which the other party is entitled to rights hereunder, endeavor to obtain or permit and aid the other to obtain proper patents thereon.

2. Publicity with reference to trans-oceanic telephony shall be joint, and shall recognize that the parties hereto, or their associates, have contributed equally to such work.

Engineering representatives shall be assigned by each of the parties to co-operate in the carrying out of the further work necessary for the development of trans-oceanic wireless telephony. In case trans-oceanic telephone service is given

from the plant of the Telephone Company through the stations of the General Company, these engineering representatives shall co-operate in the design of the apparatus and systems for this service, it being recognized that such systems and apparatus must be so designed as properly to fit in with the systems of the General and Telephone Companies respectively.

Each party shall afford the engineering representatives of the other the fullest possible facilities, consistent with the reasonable operation 4052 of the other, for experimenting and for developing and testing apparatus and systems for use in trans-oceanic telephony, and each shall at all times be given such an opportunity to make such tests, experiments and observations in the trans-oceanic stations of the other as do not conflict with the service then being rendered by such stations, and each party shall afford to the other such facilities for test, experimentation and observation on ships as it may be able to extend.

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3. In the operation of wireless and "carrier-current" communication, the parties shall co-operate to the end that interference with the operations of either party, due to the operations of the other, shall be minimized, it being recognized that the available wave lengths are limited.

ARTICLE X.

Purchases as Between Parties.

It is recognized that each party has and will normally continue to have facilities for manu-

facturing certain apparatus or parts thereof which may be required by the other party under its licenses hereunder, and that a duplication of such facilities may be wasteful and uneconomical. Each party agrees that it will upon request manufacture for and sell and deliver to the other, with reasonable business promptness, on receipt of orders from time to time, and at favorable prices not to exceed those charged to others (except controlled companies) purchas-
4055 ing in like quantities for use in the United States, such apparatus and parts as the former is engaged in manufacturing from time to time and as the latter may desire for use under the licenses granted by this agreement.

ARTICLE XI.

Litigation.

Each party shall have the exclusive right to bring suits for infringement in the fields in
4056 which its licenses are herein expressed as exclusive (and the General Company may bring such suits for infringement in the field of transoceanic wire and wireless telephony) joining in any such suit the patent owner or the party which has acquired from the patent owner the right to sue thereunder.

Neither party shall bring suit for infringement of patents against the other party, or against the distributors and jobbing houses owned by or affiliated with either party, because of sales by such party, or by its (or its controlled companies) distributors or jobbing houses, of devices made, in the United States of

America, by others than the parties hereto, it being agreed that remedy in case of any such infringement shall be only by suit against the manufacturer of those devices.

ARTICLE XII.

Releases.

Each party reserves to itself the right to deal with the United States Government with reference to settlement for past use of its inventions 4058
in telephone and telegraph systems and apparatus. Subject to the foregoing, each party releases the other and the vendees and users of apparatus or systems made by it, from all claims growing out of past infringement of patents, by reason of the manufacture, use and sale of such apparatus and systems by the other party, and its resale or use by such vendees and users.

ARTICLE XIII.

Arbitration. 4059

In case any differences under this agreement (except in respect of interferences or priority of rights to inventions or patents) shall arise which the parties are unable to adjust between themselves, either party may, by notice in writing served on the other, designate one arbitrator and call upon the other to designate a second arbitrator within thirty days after the receipt of such notice; and the party receiving such notice agrees so to designate an arbitrator. The two arbitrators so designated shall promptly select a third arbitrator. The matter in dispute

shall be submitted to the three arbitrators so selected, and the parties agree that the concurring decision of any two of the above mentioned three arbitrators shall be final and binding upon them. Each party shall pay its own expenses, including the fees of its arbitrators, and the fees and expenses of the third arbitrator shall be paid one-half by each party.

ARTICLE XIV.

4061 TERMINATION OF AGREEMENT.

(*a*) This agreement may, at any time, be terminated by mutual consent of the parties, in which event all licenses granted herein up to the date of such termination shall become non-exclusive and shall continue to the ends of the terms of the patents.

(*b*) Unless previously terminated as above provided, the duration of this agreement shall be ten years from the date hereof, but shall automatically continue in force thereafter until can-
4062 celed on three years' written notice given, after the expiration of said ten years' period, by one party to the other party.

(*c*) Upon any termination of this agreement (except under the provisions of Subdivision (*a*) of this Article XIV) all licenses, expressed herein as exclusive, shall remain exclusive during the life of the several patents.

ARTICLE XV.

FURTHER ASSURANCES.

The parties agree to execute and deliver such further instruments as may reasonably be neces-

sary for carrying out the provisions and purposes of this agreement.

ARTICLE XVI.

Successors.

This agreement is binding upon and shall enure to the benefit of each of the parties hereto and their several successors in business, except that either party may transfer or dispose of any part or parts of its business not involving the 4064
grant of any licenses under this agreement, and in such case this agreement shall not be binding upon or inure to the benefit of the successor to that part of the business so transferred.

In witness whereof, the parties hereto have caused this instrument to be executed on the day and year first above written, by their proper officers thereunto duly authorized.

General Electric Company,
By E. W. Rice, Jr.,
President. 4065

(seal)

Attest:

J. W. Elwood,
Assistant Secretary.

American Telephone &
Telegraph Company,
By H. B. Thayer,
President.

(seal)

Attest:

A. A. Marsters,
Secretary.

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Defendant's Exhibit C.

Extension Agreement.

Whereas, a license agreement was entered into between the General Electric Company, a New York corporation herein called the General Company, and the American Telephone and Telegraph Company, a New York corporation herein called the Telephone Company, dated July 1, 1920, and

Whereas, the General Company desires to extend rights thereunder to the Radio Corporation
4067 of America, a Delaware Corporation (herein called the Radio Company) pursuant to the provisions of an agreement of November 20, 1919, between the General Radio Companies; and

Whereas, the Telephone Company desires to extend rights thereunder to the Western Electric Company, Incorporated, a New York Corporation (herein called the Western Company) pursuant to the provisions of an agreement of February 6, 1882, as modified by agreement of April 8, 1908, between the Telephone and Western Companies; and
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Whereas, the Radio and Western Companies, respectively, desires to obtain such rights, but in accordance with Subdivision (*b*) of Section 3, Article VI of said agreement of July 1, 1920, such rights may be extended only with the assent of both parties to said agreement.

Now, it is agreed as follows:

1. The General Company may extend to the Radio Corporation, and the Telephone Company may extend to the Western Company (pursuant to the above mentioned agreements of November

20, 1919, February 6, 1882, April 8, 1908, or otherwise), any of the said rights reserved, and acquired by each respectively under this present agreement and under said agreement of July 1, 1920, whether or not expressed in said agreement of July 1, 1920, as personal or non-exclusive or non-assignable, except any right to terminate under the provisions of Article XIV of said agreement.

2. The Western Company hereby grants and agrees to grant to the General Company under the present and future patents of the Western Company, rights of the same character and scope, and for the same fields and subject to the same limitations and conditions, as the rights granted to the General Company in and by said agreement of July 1, 1920; PROVIDED, however, that all rights herein granted and agreed to be granted are subject to rights, which the Western Company hereby reserves for itself and for the Telephone Company and their several successors in business, of the same character and scope and for the same fields and subject to the same limitations and conditions as the rights reserved by the Telephone Company in and by said agreement of July 1, 1920. And the Western Company hereby assumes towards the General Company (and the Telephone and Western Companies assume towards the Radio Company, to the extent that the General Company, under the provisions of Clause 1 hereof, extends or may hereafter extend its rights to the Radio Company) obligations similar to the obligations assumed by the Telephone Company towards the General Company in and by said agreement of July 1, 1920, except that the Western Company assumes

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no obligations as to operation of telephone or telegraph systems unless and until it shall engage in the commercial operation of such systems.

3. The Radio Company hereby grants and agrees to grant to the Telephone Company, under the present and future patents of the Radio Company, rights of the same character and scope, and for the same fields and subject to the
4073 same limitations and conditions, as the rights granted to the Telephone Company in and by said agreement of July 1, 1920; PROVIDED, however, that all rights herein granted and agreed to be granted are subject to rights, which the Radio Company hereby reserves for itself and for the General Company and their several successors in business, of the same character and scope and for the same fields and subject to the same limitations and conditions as the rights reserved by the General Company in and by said agreement of July 1, 1920. And the Radio Com-
4074 pany hereby assumes toward the Telephone Company (and the General and Radio Companies assume towards the Western Company, to the extent that the Telephone Company, under the provisions of Clause 1 hereof, extends or may hereafter extend its rights to the Western Company) obligations similar to the obligations assumed by the General Company towards the Telephone Company in and by said agreement of July 1, 1920, except that the Radio Company assumes no obligations as to manufacturing or selling articles or devices which it is not from time to time engaged in commercially manufacturing.

4. This agreement shall terminate at the same time that the said agreement of July 1, 1920, terminates.

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed, in quadruplicate, on the first day of July, 1920, by their proper officers thereunto duly authorized.

GENERAL ELECTRIC COMPANY,
By E. W. RICE, JR.,
(SEAL) President. 4076

Attest:

J. W. ELWOOD,
Assistant Secretary.

RADIO CORPORATION OF AMERICA,
By E. J. NALLY,
(SEAL) President.

Attest:

C. J. ROSS,
Secretary.

4077

AMERICAN TELEPHONE & TELEGRAPH COMPANY,
By H. B. THAYER,
(SEAL) President.

Attest:

A. A. MARSTERS,
Secretary.

WESTERN ELECTRIC COMPANY, INC.,
By H. A. HALLIGAN,
(SEAL) President.

Attest:

GEORGE C. PRATT,
Secretary.

4078

Defendant's Exhibit D.

MODIFICATION OF LICENSE AGREEMENT

Dated July 1, 1920

GENERAL ELECTRIC COMPANY

AND

4079 AMERICAN TELEPHONE AND TELEGRAPH COMPANY

July 1, 1926

AGREEMENT dated July 1, 1926, between GENERAL ELECTRIC COMPANY, a New York corporation (herein called the General Company), and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, a New York corporation (herein called the Telephone Company).

4080 WHEREAS, the parties hereto heretofore entered into an agreement made the first day of July, 1920, granting certain reciprocal licenses primarily in respect of electrical apparatus, but because at said date the art in certain of the fields dealt with in said agreement had not progressed to a point at which it was possible fully to comprehend the problems involved, disputes have arisen between the parties as to the meaning of various provisions of said agreement; and

WHEREAS, certain provisions of said agreement are not, as a practical matter, workable in the present state of the art; and

WHEREAS, unless said disputes are settled and said agreement made workable in practice progress in the fields dealt with in said agreement will be greatly hampered and delayed, and the parties desire to modify said agreement for the purpose of settling said disputes and making said agreement workable in practice;

Now, in consideration of the premises and the mutual agreements herein contained, the parties agree each with the other as follows: 4082

I. Said agreement made the first day of July, 1920 shall be and is modified to read as follows:

AGREEMENT made the first day of July, 1920, between General Electric Company, a New York corporation (herein called the General Company), and American Telephone and Telegraph Company, a New York corporation (herein called the Telephone Company).

WHEREAS, the General Company is engaged in 4083 the manufacture and sale in the United States of apparatus and systems for the generation, distribution and utilization of electricity for light, heat, power, traction and associated purposes, and in the manufacture and sale of a general line of electrical and power apparatus, and, directly and through subsidiaries, is engaged in the purchase of apparatus of various kinds from others and in the sale thereof; and is also engaged in the manufacture and sale of wireless apparatus; and

WHEREAS, the Telephone Company and the Companies of the Bell System and their sub-

4084 *Defendant's Exhibit D.*

sidiaries are engaged in the operation of telephone and telegraph systems and in the manufacture, purchase and sale of telephone and telegraph and other electrical apparatus; and

WHEREAS, each party is in possession of information, patents and inventions applicable to, and has research organizations engaged in investigations bearing upon, not only its own business but also the business of the other party; and

4085

WHEREAS, various patents or applications for patents of the parties are involved in interference with each other in the United States Patent Office; and

WHEREAS, the restrictions upon each party imposed by the patent rights of the other and the uncertainties arising out of interferences have tended to, and if permitted to continue, will hamper and delay, progress in the development and production of wire and wireless telephone and telegraph and phonograph apparatus and systems; and

4086

WHEREAS, the effective and prompt development of the arts in question can be secured only by the free and frank co-operation and exchange of information between the parties, which can not well take place if improvements and knowledge resulting from one party's co-operation with the other party may without its consent be made available in its field to the use of others;

Now, in consideration of the premises and the mutual agreements herein contained, it is agreed as follows:

ARTICLE I.

DEFINITIONS.

For the purposes of this agreement the following terms are defined as follows:

"*Wire telephony*" is the art of communicating or reproducing sound waves (created, directly or indirectly, by the voice or by musical instruments) by means of electricity, magnetism or 4088
electro-magnetic waves, variations or impulses conveyed or guided by wires, and includes all generating, measuring, switching, signaling and other means or methods incidental to or involved in such communication.

"*Wireless telephony*" has the same meaning as "wire telephony", except that the waves, variations or impulses are radiated through space.

"*Wire telegraphy*" is the art of communicating messages by code signals (such as the Morse Code, for example) and of picture transmission, 4089
by means of electricity, magnetism or electro-magnetic waves, variations or impulses conveyed or guided by wires, and includes all generating, measuring, switching, signaling and other means or methods incidental to or involved in such communication, but does not include such devices as annunciators, elevator signals, engine room telegraphs, etc.

"*Wireless telegraphy*" has the same meaning as "wire telegraphy," except that the waves, variations or impulses are radiated through space.

"*Picture transmission*" is the art of transmitting, or receiving at another point than the point of transmission, by means of electricity, magnetism or electro-magnetic waves, variations or impulses, the aspect or shape of things, including pictures, whether still or moving, drawings, writings, forms and other graphic, printed and written matter of all kinds; and include television.

4091 "*Programs*" means pictures, news, music, speeches, sermons, advertising and entertainment, educational and similar matter, or any of them or combinations of any of them, for the purpose of exhibition, entertainment or instruction.

"*Power purposes*" means all prime movers and their accessories and all generation, use, measurement, control and application of electricity for light, heat, power and traction, but does not include any communication purpose.

4092 "*Public address system*" means a combination of one or more telephone transmitters and one or more loud speaking telephone receivers, either adjacent to said transmitters or at a distance therefrom, operating by one-way wire telephony for the reproduction of sound with increased volume, but does not include apparatus for operation in combination or connection with or as parts of apparatus for (1) wireless telephone reception, or (2) reception of programs over electric light, electric heat, electric power or electric traction lines, or (3) the production or reproduction of sound from sound records.

"*Phonographs*" means all apparatus for the reproduction of sound from sound records used in or in connection with such apparatus, to be heard in the immediate vicinity of the apparatus, but does not include apparatus for the transmission to, or reception at, other points of sound reproduced from such records.

"*Electric Phonograph*" means a phonograph in which the sound record used therein gives rise to or controls an electric current or electromotive force in such a way that the variations 4094
of the electric current or electromotive force correspond in some way to the recorded sounds, and the electric current or electromotive force directly or indirectly brings about the production of the sound from the phonograph.

"*Transoceanic*" communication means all communication which crosses any ocean, gulf or sea between two continents, or between a continent and an island more than one hundred miles from its shores (islands within one hundred miles of the shores of a continent being considered parts 4095
thereof), or between two islands which are not parts of the same continent, except that communication between ships or aircraft, between ships and aircraft, or between ships or aircraft and shore, and communication between parts of the same continent, is not transoceanic communication. North America, including the Panama Canal Zone and all of Central America north thereof, is to be considered as one continent, and South America and all of Central America south of the Panama Canal Zone as another.

"*The United States Government*" means not only the Federal Government but also the Gov-

ernments of the Philippines, Porto Rico and other federal possessions, present or future; but does not include any municipal, county or state government.

"*Train dispatching*" is telegraphic or telephonic conveyance of train orders or operating information between the office of a train dispatcher or similar official and railway trains or other automotive land vehicles (not including
4097 airplanes or airships) or points along the line of way, for directing the movements of such automotive vehicles.

"*Railway signalling*" is the operation of signals, switches, brakes, stops, crossing gates, etc., controlling or signalling the movements of trains or other automotive vehicles, controlled by or in accordance with train or vehicle movements or track conditions, including block signalling, cab signals and train stops. It does not include train dispatching.

4098

"*Apparatus*" includes machines, devices and appliances and the materials entering into the construction thereof.

"*Household devices*" are electric or electrically operated apparatus, not herein otherwise specified, designed primarily for domestic use, but do not include apparatus for communication purposes.

"*Homes*" means all places of residence, permanent or temporary, including, however, as to hotels, hospitals and club houses only the private living rooms thereof.

"*Amateur*" means one, not a professional investigator, who is more than a mere broadcast listener and who evidences his interest in the art of wireless telephony by study, investigation or experiment in the art.

"*Subsidiaries*" of either party are corporations a majority of whose stock having power to vote for the election of directors is owned, directly or indirectly, either by such party, or by such party and one or more of its other subsidiaries, or by one or more of its other subsidiaries. The party hereto so controlling, directly or indirectly, any subsidiary is herein called the "*parent company*" of such subsidiary. 4100

"*Companies of the Bell System*" are those companies which, in connection directly or indirectly with the Telephone Company, provide a telephone service throughout the United States, or from the United States to foreign countries. These companies at present comprise the Telephone Company, Western Electric Company, Incorporated, Cuban American Telephone and Telegraph Company, and the so-called Associate Companies and Connecting Companies, and their several subsidiaries. 4101

Any dispute arising as to the meaning or application of the foregoing definitions shall be settled by arbitration, as hereinafter provided.

ARTICLE II.

The Patents Included in this Agreement.

The licenses provided for herein are granted and agreed to be granted under all patents, and rights to or under patents, of the United States

now or hereafter during the term of this agreement owned or controlled by the parties hereto, and under all such patents hereafter issued upon inventions now or hereafter during said term so owned or controlled, and to the extent to which the parties have or may have the right to grant licenses, in so far as the inventions covered by such patents are or shall be applicable to the respective fields for which said licenses are expressed as granted or to be granted, excepting
4103 (1) as otherwise specified in connection with the several grants hereinafter contained, and (2) such patents and inventions as may hereafter be excluded from the operation of this agreement in the following manner:

A list of all United States patents under which it now holds transferable rights shall be furnished by each party to the other within sixty days from the date of this agreement. Such lists shall separately identify those patents, and shall also include those applications, as to which rights, if granted hereunder, would be restricted
4104 in scope or would involve continuing obligations not implied by law. Copies of all contracts creating such restrictions or obligations shall, upon request, be furnished by each party to the other. Thereupon, and within six months after the receipt of the lists to be furnished as aforesaid, each party may in writing advise the other as to the patents and applications described in such list, furnished by the other, which (or the patents to issue on which) it desires to exclude from this agreement; and no licenses are granted by this agreement under any patents so excluded.

Each party shall thereafter, at such periods as

may be agreed upon, or whenever requested by the other party, furnish to such other party like lists of subsequent patents and applications, and upon request therefor like copies of contracts; and each party may, within six months after the receipt of any such list, advise the other in writing as to the patents and applications described in such list which (or the patents to issue on which) it desires to exclude from this agreement; and no licenses are granted by this agreement under any patents so excluded. 4106

ARTICLE III.

Scope of Licenses.

1. All of the licenses herein granted are, unless otherwise expressed in connection with the several grants, licenses to use methods and processes, and to make, use, sell, lease or otherwise dispose of apparatus and systems in the fields in which the licenses are granted.

4107

2. A license to make apparatus includes a license to have such apparatus manufactured for the licensee by others, subject to the provisions of this article III and article X of this agreement. No rights are granted to either party to manufacture or to have manufactured, under patents under which it receives licenses hereunder, apparatus of the character at the time manufactured by the other party, except in factories owned or operated by one or the other of the parties hereto, or by their subsidiaries, without the written consent of the party granting such licenses.

4108 *Defendant's Exhibit D.*

3. Every license herein granted to either party includes, unless otherwise herein provided, all incidental rights necessary to the full enjoyment and exercise of the license granted, notwithstanding that such incidental rights may lie primarily in a field in which the other party is herein granted a license which is denominated exclusive.

4. The making, using, selling, leasing or otherwise disposing of parts is subject to the same
4109 restrictions and conditions as are applicable under this agreement to apparatus of which they are or may be parts.

ARTICLE IV.

Reservations and Exceptions to Which the Licenses Are Subject.

1. Each party reserves, under its own patents, a non-exclusive right to make for and sell or lease to the United States Government wireless apparatus and systems for use only for
4110 other than commercial or toll purposes, and to grant to that government non-exclusive licenses to make or have made for it and to use wireless apparatus and systems, but only for other than commercial or toll purposes; and all exclusive licenses herein granted are subject to this reservation.

2. Each party reserves, under its own patents, rights in the fields and for the purposes with reference to which, and to the extent to which, it receives licenses under patents of the other party.

3. All exclusive licenses herein granted to either party are subject to licenses specifically herein granted to the other party and to rights incidental to the full enjoyment and exercise of all licenses granted to the other party, except as herein otherwise expressly provided.

4. No licenses are granted by either party with reference to the manufacture or sale of wire or cable for the transmission of electric current for light, heat, traction or other power 4112 purposes, or for telephone or telegraph purposes.

COPY

February 25, 1930.

G. E. Folk, Esq.,
American Telephone & Telegraph Co.,
195 Broadway,
New York City, N. Y.

4113

Dear Mr. Folk:

We understand that you are aware that the United States Government has raised objections to inclusion of the provision quoted hereunder in bids for radio apparatus:

"This bid is made with the understanding that the apparatus furnished thereunder will be licensed under patents under which the bidder has the right to grant licenses for use or sale only for other than toll or

4114 *Defendant's Exhibit D.*

commercial purposes except to such extent as has been or may be prescribed by the Congress."

In prior discussion you have indicated that your company has no objection to sales of apparatus on contracts which omit the above provision. Under the circumstances and to make it a matter of record, we would like to have your company confirm this understanding and agree with us
4115 that the modification agreement dated July 1, 1926, Article V, Paragraph 1, entitled "Government Uses" should be amended by cancelling the words, "for use only for other than commercial or toll purposes."

We are sending herewith two signed copies of this letter. If the proposal meets with your approval kindly sign and return one copy to indicate your acceptance of the modification.

Very truly yours,

4116 GENERAL ELECTRIC COMPANY,
(Sgd.) ALBERT G. DAVIS,
Vice President.

3/10/30
Approved until further notice.

(Sgd.) WALTER GIFFORD,
President - A. T. & T. Co.

5. No licenses are granted to the Telephone Company for electric lamps or other lighting apparatus (except non-exclusive licenses with reference to telephone and telegraph signal lamps

and telephone and telegraph ballast lamps for use solely in fields in which the Telephone Company is otherwise licensed under this agreement), nor for the working of tungsten. But the Telephone Company is licensed to use, in the fields for which it receives licenses hereunder, tungsten purchased from the General Company, or from others having the right to make and sell tungsten, and to make, use, sell or lease (for such fields only) devices embodying such tungsten. The General Company agrees to sell and 4118
deliver such tungsten for such purposes, in wire or other practicable form to be specified by the purchaser from time to time, on the terms specified in article X hereof.

The Telephone Company agrees that, on all sales of telephone and telegraph signal lamps or telephone and telegraph ballast lamps, hereunder, to others than Companies of the Bell System, (other than lamps licensed under paragraph (*d*) of subdivision C of section 4 of article V hereof), it will pay to the General Company a royalty of 2% on the net sales price thereof. 4119

6. The licenses herein granted to the Telephone Company, in so far as they cover rights to sell or lease carrier current, wireless or vacuum tube apparatus for use on electric railroads, are limited to sales or leases of said apparatus to the railroads; the sale of such apparatus to be installed in electric cars and electric locomotives designed or built by the General Company, as part of the original construction and equipment thereof, shall be through the General Company only.

4120 *Defendant's Exhibit D.*

ARTICLE V.

Licenses Granted.

Subject to the foregoing reservations, each party grants and agrees to grant to the other the following licenses in the following fields of use:

1. Government Uses.

4121 Each party grants to the other non-exclusive licenses to make for, and sell or lease to, the United States Government wireless apparatus and systems for use only for other than commercial or toll purposes.

2. Wireless Telegraphy.

(*a*) The General Company grants to the Telephone Company licenses in the field of wireless telegraphy, exclusive except as in this paragraph (*a*) provided, for combined wireless tele-
4122 phone and telegraph sets for use on ships; but where such combined sets are for use on ocean-going and coastwise ships of American registry (excluding harbor tug-boats and other harbor craft) the exclusive right to use, lease, sell or otherwise dispose of the same is granted by the Telephone Company to the General Company. The Telephone Company agrees upon request to make such sets and sell them for such use to the General Company upon reasonable terms.

(*b*) The General Company grants to the Telephone Company non-exclusive licenses in the field of wireless telegraphy to make and use (but not

to sell, lease or otherwise dispose of, except to Companies of the Bell System) apparatus and systems for its own communication or that of Companies of the Bell System, and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement, but not for transmission of messages for the public except temporarily in emergencies due to storms or other catastrophes.

(*c*) The General Company grants to the Tele- 4124
phone Company non-exclusive licenses in the field of wireless telegraphy to make and use (but not to sell, lease or otherwise dispose of, except leases to subscribers in connection with a service given by Companies of the Bell System in this paragraph described) apparatus and systems for the purpose of giving within the continental United States, and between the continental United States and other parts of continental North America, a business, commercial or official service limited to a particular customer or class of customers and analogous to the service given by 4125
Companies of the Bell System by wire telegraphy at the date of this agreement, commonly designated as leased wire or special contract service, but said licenses do not include the making or using of such apparatus for (1) transmission or reception for the public generally or (2) transoceanic communication or (3) transmission or reception of programs; and the licenses granted to, and the rights reserved by, the Telephone Company for the purposes covered by this paragraph (*c*) include only apparatus for the reception of such service which shall be adapted for reception only upon the wave lengths (not

exceeding as to any set three specific wave lengths) upon which such service is given.

(*d*) The General Company grants to the Telephone Company non-exclusive licenses in the field of wireless telegraphy to make and use (but not to sell, lease or otherwise dispose of, except to Companies of the Bell System) apparatus and systems for television for use solely in combination with apparatus and systems for two-way tel-
4127 ephony for the purpose of giving a public service combining television and speech, but said licenses do not include the making or using of such apparatus for transmission or reception of programs.

(*e*) The General Company grants to the Telephone Company non-exclusive licenses in the field of wireless telegraphy for combined wireless telephone and telegraph sets, other than sets for transoceanic communication, (1) for use in communication by, with and between airplanes, air-
4128 ships and other automotive devices other than ships and railway vehicles, and (2) for export from the continental United States for use for any purpose other than transoceanic communication.

(*f*) Subject to non-exclusive rights reserved for the purpose described in paragraphs (*b*), (*c*), (*d*) and (*e*), of this section 2, the Telephone Company grants to the General Company exclusive licenses for all purposes in the field of wireless telegraphy other than for the purposes covered by paragraph (*a*) of this section 2 and by section 8 of this article V.

(*g*) The licenses granted to the General Company in this section 2 do not cover the use of wireless telegraph stations for giving a telephone service, except as licensed in section 4 of this article V. The General Company agrees that the surplus facilities of said stations of the General Company shall, upon request of the Telephone Company, be made available to the Telephone Company or its sub-licensees, upon reasonable terms to be agreed upon by the parties, for giving a two-way telephone service; and 4130
it shall be a condition of every sub-license granted by the General Company under the licenses granted to it in this section 2 that the sub-licensee shall be under like obligation in respect of its wireless telegraph stations embodying any invention in respect of which it is granted such sub-license.

3. Wire Telegraphy.

(*a*) The Telephone Company grants to the General Company exclusive licenses in the field 4131
of wire telegraphy for the transmission and reception of programs over electric light, electric heat, electric power and electric traction lines, subject, however, to the provisions of paragraph (*b*) of section 5 of this article V regarding electrical interference.

(*b*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telegraphy to make (but not to sell, lease or otherwise dispose of) apparatus and systems, and (1) to use such apparatus and systems for its own communication and for use

solely as an incidental facility in fields in which it is otherwise licensed under this agreement, and (2) to use such apparatus and systems upon wire telegraph systems owned by it, or leased to it, for its operation (other than transoceanic cables), for all purposes other than giving a service by wire telegraphy analogous to the service given by the Companies of the Bell System by wire telegraphy at the date of this agreement, commonly designated as leased wire or
4133 special contract service, and other than train dispatching; but no licenses are granted with reference to transoceanic wire telegraphy.

(*c*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telegraphy for apparatus and systems for communication only in connection with the operation of apparatus for power purposes, but not for transmission of messages for the public.

(*d*) The Telephone Company grants to the
4134 General Company non-exclusive licenses in the field of wire telegraphy for apparatus and systems for communication between parts of a train (without regard to the nature of the motive power thereof), or between trains following or approaching each other upon the same system of tracks, or between trains approaching a cross-over or junction point of the systems of tracks upon which they are running, or between trains and signal towers or way-stations within short distances thereof, but in each instance only for use in connection with the operation of such trains but not for train dispatching.

(*e*) Subject to non-exclusive rights reserved for the purposes described in paragraph (*b*), (*c*) and (*d*) of this section 3, the General Company grants to the Telephone Company exclusive licenses for all purposes in the field of wire telegraphy (other than that covered by paragraph (*a*) of this section 3) on land, and over ocean cables not more than one hundred miles in length, and between the main body of the United States and Cuba; but no licenses are granted with reference to other transoceanic wire telegraphy. 4136

4. Wireless Telephony.

A. In general.

(*a*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wireless telephony to make and use (but not to sell, lease or otherwise dispose of) apparatus and systems for its own communication and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement, but not for transmission of messages (as distinguished from programs) for the public except temporarily in emergencies due to storms or other catastrophes. 4137

(*b*) The Telephone Company grants to the General Company exclusive licenses in the field of amateur wireless telephony, subject to non-exclusive rights reserved for the purposes and subject to the limitations hereinafter in this paragraph (*b*) provided; and the General Company grants to the Telephone Company non-exclusive licenses to make and sell apparatus in the field

of amateur wireless telephony limited as hereinafter in this paragraph (*b*) provided. The licenses by this paragraph (*b*) granted by the Telephone Company to the General Company shall be free of royalties, but all apparatus sold by the Telephone Company under the licenses granted by this paragraph (*b*) shall be treated as if such apparatus were apparatus for one-way wireless telephone reception of programs under the provisions of paragraph (*d*) of subdi-
4139 vision C of this section 4 and shall be governed by all the provisions of said paragraph (*d*).

(*c*) Each party grants to the other non-exclusive licenses for headphones for all purposes in all fields covered by this agreement; provided, however, that headphones sold by the Telephone Company as part of complete apparatus for one-way wireless telephone reception of programs shall be included in the determination of the royalties payable by the Telephone Company under the provisions of paragraph (*d*) of subdi-
4140 vision C of this section 4.

(*d*) Each party grants to the other non-exclusive licenses in the field of wireless telephony for apparatus and systems for communication only in connection with the operation of apparatus for power purposes, but not for transmission of messages for the public.

(*e*) Each party grants to the other non-exclusive licenses in the field of wireless telephony for apparatus and systems for communication between parts of a train (without regard to the nature of the motive power thereof), or between

trains following or approaching each other upon the same system of tracks, or between trains approaching a cross-over or junction point of the system of tracks upon which they are running, or between trains and signal towers or way-stations within short distances thereof, but in each instance only for use in connection with the operation of such trains but not for train dispatching.

B. TWO-WAY WIRELESS TELEPHONY. 4142

(*a*) The General Company grants to the Telephone Company exclusive licenses in the field of two-way transoceanic wireless telephony to make and use (but not to sell, lease or otherwise dispose of) apparatus and systems for use in the continental United States; but such licenses do not include use for transmission or reception of messages offered for telephonic transmission.

(*b*) The General Company grants to the Telephone Company non-exclusive licenses in the field of two-way transoceanic wireless telephony, to make and sell to stations outside the continental United States engaged in cooperation with the Telephone Company in giving for the public a transoceanic telephone service, apparatus for use in giving such service; and subject to non-exclusive rights reserved for the purposes described in the foregoing clause of this paragraph (*b*), the Telephone Company grants to the General Company exclusive licenses in the field of two-way transoceanic wireless telephony for apparatus for export from the continental United States. 4143

(*c*) The Telephone Company grants to the General Company non-exclusive licenses in the field of two-way wireless telephony for combined wireless telephone and telegraph sets, other than sets for transoceanic communication, (1) for use in communication by, with and between airplanes, airships and other automotive devices other than ships and railway vehicles, and (2) for export from the continental United States for use for any purpose other than transoceanic communi-
4145 cation.

(*d*) Subject to non-exclusive rights reserved for the purposes described in paragraph (*c*) of this subdivision B, the General Company grants to the Telephone Company exclusive licenses in the field of two-way wireless telephony (other than in the field of transoceanic wireless telephony) for all purposes other than the purposes covered by subdivision A of this section 4.

(*e*) The licenses granted to the Telephone Com-
4146 pany in this subdivision B do not include the use of wireless telephone stations for giving a telegraph service, except as licensed in section 2 of this article V. The Telephone Company agrees that the surplus facilities of said stations of the Telephone Company shall, upon request of the General Company, be made available to the General Company or its sub-licensees, upon reasonable terms to be agreed upon by the parties, for giving a wireless telegraph service; and it shall be a condition of every sub-license granted by the Telephone Company under the licenses granted to it in this subdivision B that the sub-licensee shall be under like obligation in respect of its

wireless telephone stations embodying any invention in respect of which it is granted such sub-license.

C. ONE-WAY WIRELESS TELEPHONY.

(*a*) Each party grants to the other non-exclusive licenses in the field of one-way wireless telephony for apparatus and systems for the purpose of giving a business, commercial or official service limited to a particular customer or class 4148
of customers; but the licenses granted by this paragraph (*a*) do not include the making or using of such apparatus for (1) transmission or reception of messages for the public generally or (2) transmission or reception of programs; and the licenses granted to, and the rights reserved by, the Telephone Company for the purposes covered by this paragraph (*a*) include only apparatus for the reception of such service which shall be adapted for reception only upon the wave lengths (not exceeding as to any set three specific wave lengths) upon which such service 4149
is given and only apparatus for the transmission of such service from and within the continental United States.

(*b*) Each party grants to the other non-exclusive licenses in the field of one-way wireless telephony for apparatus and systems for use for transmitting for purposes other than that covered by paragraph (*a*) of this subdivision C, including, however, apparatus for wireless telephone reception furnished as a part of the equipment of transmitting stations; but the licenses granted by this paragraph (*b*) do not include

apparatus in the field of amateur wireless telephony.

(*c*) The General Company grants to the Telephone Company non-exclusive licenses to make and use (but not to sell, lease or otherwise dispose of, except to Companies of the Bell System) apparatus for one-way wireless telephone reception (including apparatus for the reception of programs) for its own communication or that
4151 of Companies of the Bell System, and for use solely as an incidental facility in fields in which it is otherwise licensed under this agreement.

(*d*) The General Company grants to the Telephone Company non-exclusive licenses to make and sell (but not to lease or otherwise dispose of) apparatus for one-way wireless telephone reception of programs, but not for use in combination or connection with phonographs; provided, however, that the licenses granted in this paragraph (*d*) shall be subject to the following terms
4152 and conditions:

(1) Tubes (thermionic devices) sold as separate devices for use in apparatus covered by this paragraph (*d*), or in apparatus which under other provisions of this agreement shall be treated as apparatus covered by this paragraph (*d*), shall be free of royalties to the amount of $2,000,000 during each calendar year, and said tubes in excess of said amount in any year shall be subject to a royalty of fifty per cent. computed as hereinafter provided; provided that in no event shall tubes sold free of royalty exceed 1,000,000 in number during any calendar year;

and provided further that where said tubes are sold as parts of receiving sets or other complete units designed for operation with such sets, such tubes shall be treated as parts of the receiving set or other unit and shall not be classified under this sub-paragraph (1).

(2) Receiving sets and apparatus which under other provisions of this agreement shall be treated as apparatus covered by this paragraph (*d*), or parts thereof (including loud speakers, amplifiers and tubes other than thermionic devices), 4154
shall be free of royalty to the aggregate amount of $3,000,000 in each calendar year, and such sets, apparatus or parts in excess of said amount shall be subject to a royalty of fifty per cent. computed as hereinafter provided; provided that if the sales of tubes sold as separate devices amount to less than $2,000,000 during any year, the amount of such deficiency shall be added to the amount of receiving sets, apparatus and parts which may be sold free of royalty in the same year. 4155

(3) For any portion of the first or last calendar year of this agreement, less than an entire calendar year, during which royalties shall be payable hereunder, the amounts which may be sold free of royalty shall be that proportion of the amounts which may be sold free of royalty in the entire calendar year which said fractional part of a calendar year bears to a calendar year.

(4) The licenses granted to the Telephone Company in this paragraph (*d*) to sell apparatus for one-way wireless telephone reception of pro-

grams (and the licenses to sell apparatus which under other provisions of this agreement shall be treated as apparatus covered by this paragraph) are licenses for sale only at retail (except as to sales for export), either directly or through the Telephone Company's own direct agents and are subject to the condition that the Telephone Company shall retain in itself, or in one or more of its subsidiaries, title to the apparatus and control of its disposition until it
4157 is so sold.

(5) The aforementioned amounts sold free of royalty, and the amounts subject to royalty, shall (except as to sales for export) be based on the actual price at which the apparatus is sold at retail.

(6) Sales for export shall be included in determining the amounts sold free of royalty, and the amounts subject to royalty, on the basis of the price at which the sale is made.

4158

(7) In ascertaining the amount of the sales which are free from royalty and the amount of the sales upon which royalties are to be paid hereunder, where apparatus is sold any part of which embodies any invention of any of the patents included in this agreement, the selling price of the apparatus sold shall be taken as the basis; but apparatus not covered by any of the patents of the parties, when sold not assembled for operation with apparatus covered by such patents, shall not be taken into account in computing the amounts of sales which are free from royalty or the amount of sales which are subject to royalty,

unless such apparatus not covered by such patents is adapted for operation with apparatus covered by such patents and is sold in such manner that its sale or its use in connection with apparatus covered by such patents would, except for the licenses granted by this agreement constitute contributory infringement of patents of the parties under which exclusive licenses are granted to the General Company by this agreement. Where radio receiving sets are sold for use in combination with apparatus primarily de- 4160
signed as public address systems the sale price of the public address apparatus shall not be included in the amount of the sales which are free from royalty or the amount of the sales which are subject to royalty. Chemical primary batteries, wet or dry, and chemical storage batteries, not sold as part of apparatus upon which royalties are payable hereunder, or wiring in a building in connection with a sale of such apparatus, shall not be taken into account in computing the amount of sales which are free from royalty or the amount of sales which are subject to royalty. 4161

August 26, 1930.

The American Telephone and Telegraph
Company,
195 Broadway,
New York, N. Y.

Gentlemen:

Referring to the agreement between us dated July 1, 1926, modifying the license agreement

dated July 1, 1920, it is proposed that the arrangements set forth below be made effective:

In consideration of the rights hereinafter granted to the General Company by the Telephone Company and upon the conditions herein contained the General Company agrees that the provisions as to the methods of sale contained in sub-paragraph 4 of paragraph (d) of Sub-Division C of Section 4 of Article V of said agreement dated July 1, 1926, shall not apply
4163 to sales made by the Telephone Company or its subsidiaries of the following apparatus:

(1) Apparatus for one-way wireless reception of programs, except where such apparatus is for use in homes, and

(2) Loudspeakers, whether for use in homes or otherwise; provided, however, that the retail list prices of such apparatus shall be regarded as the actual selling prices thereof for the purposes of computing the
4164 amounts sold free of royalty, and the amounts subject to royalty.

The Telephone Company grants to the General Company the right (which the General Company may extend to the Westinghouse Electric and Manufacturing Company and the Radio Corporation of America and their wholly owned subsidiaries) to use and sell, in combination with apparatus used and sold under the licenses granted in paragraph (d) of Section 5 of Article V of said agreement of July 1, 1926, close-talking microphones manufactured by the West-

ern Electric Company, Incorporated, for announcing purposes to permit the voice of a speaker talking directly into the microphone to be reproduced by loud-speaking telephone receivers before an assembled audience or in rooms within a building or group of substantially adjacent buildings commonly owned or operated; provided, however, that no rights are herein granted for any uses of such microphones or other apparatus otherwise than to reproduce announcements spoken directly into (*i. e.* not more than 4166
a few inches away from) such close-talking microphones.

It is agreed that the rights granted by the General Company are granted upon the condition that the Western Electric Company, Incorporated, shall sell to the General Company (either directly or through the Graybar Electric Company, Inc.) all close-talking microphones required by the General Company for the purposes above described at said Graybar Electric Company's lowest established selling prices plus seven and one-half per cent. (7½%) to be in- 4167
cluded in the billing for such microphones.

The arrangement set forth in this letter shall become effective between the parties immediately upon acceptance in writing by the Telephone Company and shall remain, in effect until changed or terminated upon ninety (90) days' written notice given by either party to the other, provided that such notice shall in no event be given prior to six months from date of acceptance hereof by the Telephone Company.

If the above arrangements are satisfactory to you, will you please indicate your acceptance

thereof on this letter, which is written in triplicate, and return the two copies to us.

Yours very truly,

GENERAL ELECTRIC COMPANY,
(Sgd.) By GERARD SWOPE,
President.

Accepted:

4169 AMERICAN TELEPHONE & TELEGRAPH COMPANY,
(Sgd.) By WALTER S. GIFFORD,
President.

J. H. R.
C. M.

(*e*) Subject to non-exclusive rights reserved for the purposes covered by paragraphs (*b*), (*c*) and (*d*) of this subdivision C, the Telephone Company grants to the General Company exclusive licenses for apparatus and systems for
4170 one-way wireless telephone reception of programs.

(*f*) Subdivision A of this section 4 and paragraphs (*a*) to (*e*), inclusive, of this subdivision C are intended to make provision for all anticipated fields of use of apparatus for one-way wireless telephone reception. If it should develop that there are other fields of use of such apparatus not covered herein licenses shall be granted in such other fields of use to the respective parties in accordance with the principle underlying said other paragraphs of this subdivision C, with special reference to the interest of the General

Company in the field of one-way wireless telephone reception of programs, on the one hand, and of the Telephone Company in the field of one-way wireless telephone reception for giving a service of a business, commercial or official nature, on the other hand. If the parties can not agree with respect to such licenses, their respective rights shall be determine by arbitration in accordance with the provisions of article XIII.

5. Wireless Telephony. 4172

(*a*) The Telephone Company grants to the General Company exclusive licenses, subject to non-exclusive rights reserved for the same purposes, and the General Company grants to the Telephone Company non-exclusive licenses, in the field of wire telephony for apparatus for carrier current telephone communication, both one-way and two-way, over electric light, electric heat, electric power and electric traction lines, or partly over such lines and partly across wireless gaps, but in each instance only for the use 4173 of the owner or operator of such lines in the business of such owner or operator, and not for transmission of messages for the public except temporarily in emergencies due to storms or other catastrophes.

(*b*) The Telephone Company grants to the General Company exclusive licenses in the field of one-way wire telephony for apparatus for the transmission and reception of programs over electric light, electric heat, electric power and electric traction lines including the use of such lines for pick-up lines or for connecting two or

more separate electric systems in connection with the transmission or reception of programs over such lines or by means of wireless telephony, but not including the use of other wires for such purposes except as licensed in paragraph (*c*) of this section 5; provided, however, that no apparatus is licensed under this paragraph (*b*), or under paragraph (*a*) of section 3 of this article V, the use of which would electrically interfere unreasonably with the Telephone Company's systems
4175 of wire communication for which it is licensed under this agreement, as the same may now exist or may hereafter normally be developed, or with the Telephone Company's exclusive field of transmitting programs by wire telephony over lines other than electric light, electric heat, electric power and electric traction lines, and the Telephone Company shall be the sole judge of the existence of such unreasonable interference. The Telephone Company agrees whenever requested by the General Company, but at the expense of the General Company consented to by
4176 it before being incurred, to co-operate with the General Company in every reasonable way to enable the General Company to develop apparatus within the licenses granted by this paragraph (*b*) which will avoid such electrical interference.

(*c*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony, both one-way and two-way, to make (but not to sell, lease, or otherwise dispose of) apparatus and systems, and to use such apparatus and systems solely upon systems owned by it, for its own communication and for use solely as an incidental facility in fields in

which it is otherwise licensed under this agreement, but not for transmission of messages (as distinguished from programs) for the public except temporarily in emergencies due to storms or other catastrophes. The Telephone Company agrees to furnish to the General Company, when requested, pick-up or connecting wires, if available, for its use in the transmission of programs to or from its stations for such transmission either by means of wireless telephony or over electric light, electric heat, electric power and 4178
electric traction lines, or for its use in electrical sound recording, on terms at least as favorable as the terms given to others than the General Company, and agrees that in furnishing such pick-up and connecting wires for such service there shall be no discrimination against the General Company; and, in addition to and without limitation of the licenses granted by the foregoing clauses of this paragraph (*c*), the General Company reserves non-exclusive rights in the field of wire telephony under its own patents only, for use in connection with providing for 4179
itself or obtaining from others such service or facilities if the Telephone Company shall in any case fail to furnish the same, and the non-exclusive rights so reserved may be assigned to or otherwise availed of by any other party from which the General Company shall obtain service or facilities.

(*d*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony for apparatus for the distribution to an assembled audience, or to rooms within a building or a group of substantially ad-

jacent buildings commonly owned or operated, of matter re-transmitted from apparatus for one-way wireless telephone reception, or from apparatus for reception in the field covered by paragraph (*b*) of this section 5, or from phonographs, in each case located in the immediate vicinity of such audience or within the building or group of buildings within which such distribution is made.

4181 (*e*) The Telephone Company grants to the General Company non-exclusive licenses in the field of wire telephony, both one-way and two-way, for apparatus and systems for communication only over wires used in connection with apparatus for remote control or actuation of apparatus for power purposes and only in connection with the operation of apparatus for power purposes, but not for transmission of messages for the public.

(*f*) The Telephone Company grants to the General Company non-exclusive licenses in the field
4182 of wire telephony, both one-way and two-way, for apparatus for communication between parts of a train (without regard to the nature of the motive power thereof), or between trains following or approaching each other upon the same system of tracks, or between trains approaching a cross-over or junction point of the systems of tracks upon which they are running, or between trains and signal towers or way-stations within short distances thereof, but in each instance only for use in connection with the operation of such trains but not for train dispatching.

(*g*) Subject to non-exclusive rights reserved for the purposes covered by paragraphs (*c*), (*d*),

(*e*) and (*f*) of this section 5, the General Company grants to the Telephone Company exclusive licenses in the field of wire telephony, both one-way and two-way, for all purposes other than for the purposes covered by the paragraphs (*a*) and (*b*) of this section 5; provided, however, (1) that the licenses granted by this paragraph (*g*) for apparatus for reception of programs are licenses only to make and use in connection with a service of transmitting programs by wire telephony over lines other than electric light, 4184
electric heat, electric power and electric traction lines, to lease to subscribers to such a service, and to sell only at retail (except as to sales for export) either directly or through the Telephone Company's own direct agents, and said licenses are subject to the condition that the Telephone Company shall retain in itself, or in one or more of its subsidiaries, title to the apparatus and control of its disposition until it is so sold, and (2) that all apparatus made, used, sold, leased or otherwise disposed of by the Telephone Company for distributing to an assembled 4185
audience or to rooms within a building or a group of substantially adjacent buildings commonly owned or operated, programs re-transmitted from apparatus for one-way wireless telephone reception or from apparatus in the field covered by paragraph (*b*) of this section 5, in each case located in the immediate vicinity of such audience or within the building or group of buildings within which such distribution is made, shall be treated as if such apparatus were apparatus for one-way wireless telephone reception of programs under the provisions of paragraph (*d*) of subdivision C of section 4 of this article V, and

shall be governed by all the provisions of said paragraph (*d*).

6. Power Purposes and Household Devices.

The Telephone Company grants to the General Company exclusive licenses in the fields of (*a*) distance actuation and control by wireless, (*b*) power purposes (including apparatus for distance actuation and control of apparatus for
4187 power purposes and apparatus for indicating at remote points the condition or position, of apparatus for power purposes) and (*c*) household devices, in each case for purposes other than communication purposes; provided, however, that in so far as concerns patents for inventions relating to business of the general character which any subsidiary of the Telephone Company now conducts as jobber and any extensions of that business along similar lines (except patents covering articles of the general character which such subsidiary now purchases from the General Com-
4188 pany, or its subsidiaries, or sells as agent for the same), the Telephone Company reserves under its own patents (but is granted no license under the patents of the General Company) the non-exclusive right for such subsidiaries to make apparatus embodying the inventions of said patents, or have them made for them, and to sell them in said jobbing business.

7. Railroad Signalling, Radio Goniometry X-ray Devices.

(*a*) The General Company grants to the Telephone Company non-exclusive licenses in the

field of radio goniometry for apparatus for use as part of apparatus in respect of which the Telephone Company is otherwise licensed under this agreement.

(*b*) The General Company grants to the Telephone Company non-exclusive licenses in the field of railway signalling for apparatus incidental to apparatus for train dispatching, for use only by the train dispatcher or similar official for operating at will, and not automatically, signals, 4190
switches, brakes and stops.

(*c*) Subject to non-exclusive rights reserved for the purposes covered by paragraphs (*a*) and (*b*) of this section 7, the Telephone Company grants to the General Company exclusive licenses in the fields of railroad signalling, X-ray apparatus and apparatus associated therewith, and radio goniometry.

8. Train Dispatching.

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The General Company grants to the Telephone Company exclusive licenses in the field of train dispatching.

9. Electric Sound Recording.

(*a*) The General Company grants to the Telephone Company exclusive licenses for electrical apparatus for the production of sound records (which records are for the private use of the maker, and not for commercial use or sale) in combination or connection with apparatus in the field of wire telephony other than in connection

with apparatus in the field covered by paragraph (*b*) of section 5 of this article V.

(*b*) The Telephone Company grants to the General Company exclusive licenses for electrical apparatus for the production of sound records (which records are for the private use of the maker, and not for commercial use or sale) in combination or connection with apparatus for one-way wireless telephone reception of pro-
4193 grams and with apparatus in the field covered by paragraph (*b*) of section 5 of this article V.

(*c*) The Telephone Company grants to the General Company exclusive licenses for electrical apparatus for the production in homes (which records are for the private use of the maker and not for commercial use or sale) of sound records of entertainment and educational matter, other than apparatus covered by paragraphs (*a*) and (*b*) of this section 9.

4194 (*d*) Each party grants to the other non-exclusive licenses for electrical apparatus for the production of sound records other than apparatus covered by paragraphs (*a*), (*b*) and (*c*) of this section 9.

(*e*) Nothing in this section 9 contained shall be construed as granting to either party any exclusive license with respect to electrical apparatus for the production of sound records for commercial use or sale, or for the production of master records intended to be used in manufacturing sound records for commercial use or sale.

10. Electrical Phonographs.

(*a*) The General Company grants to the Telephone Company exclusive licenses for electrical phonographs for use in combination or connection with apparatus in the field of wire telephony other than in combination or connection with apparatus in the field covered by paragraph (*b*) of section 5 of this article V; provided, however, that the licenses granted by this paragraph (*a*) for phonographs for private use in 4196
homes for entertainment and educational purposes are licenses only to make and use in connection with a service of transmitting programs by wire telephony over lines other than electric light, electric heat, electric power and electric traction lines, to lease to subscribers to such a service, and to sell only at retail (except as to sales for export) either directly or through the Telephone Company's own direct agents, and said licenses are subject to the condition that the Telephone Company shall retain in itself, or in one or more of its subsidiaries, title to the ap- 4197
paratus and control of its disposition until it is so sold.

(*b*) The Telephone Company grants to the General Company exclusive licenses for electrical phonographs in combination or connection with apparatus for one-way wireless telephone reception, and in combination or connection with apparatus in the field covered by paragraph (*b*) of section 5 of this article V.

(*c*) The Telephone Company grants to the General Company exclusive licenses for electri-

cal phonographs for private use in homes for all entertainment and educational purposes other than those covered by paragraphs (*a*) and (*b*) of this section 10.

(*d*) Each party grants to the other non-exclusive licenses for electrical phonographs for all purposes other than those covered by paragraphs (*a*), (*b*) and (*c*) of this section 10.

4199 *11. Apparatus for Co-ordination of Sound and Pictures.*

(*a*) The rights and licenses of the parties hereto in respect of apparatus for transmitting, receiving, recording or reproducing sound in co-ordination, synchronism or timed relation with the taking, transmission or projection of pictures shall, in so far as the fields of wire and wireless telegraphy and telephony, electrical sound recording and electrical phonographs are involved, be governed by the other provisions of this agreement relating to said fields.

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(*b*) In so far as apparatus for the taking or projection of pictures and apparatus for co-ordinating, synchronizing or timing such taking or projection in relation to the recording or reproduction of sound are not covered by the provisions of paragraph (*a*) of this section 11, the Telephone Company grants to the General Company exclusive licenses for such apparatus for private use in homes for entertainment and educational purposes, and each party grants to the other non-exclusive licenses for such apparatus for all other purposes.

12. Submarine Signaling, Scientific and Therapeutic Apparatus, Shop Expedients and Other Applications.

Each party grants to the other, non-exclusive licenses in the following fields:

Submarine signaling.

Scientific apparatus for use of laboratories, colleges and scientific societies, as distinguished from commercial use. 4202

Wireless apparatus for use of professional investigators (as distinguished from amateurs) for experimental purpose only.

Therapeutic apparatus other than X-ray devices and appliances.

Shop tools, appliances, materials and processes, but only for the production of apparatus embodying inventions which the grantee is licensed to make and use hereunder.

All applications, not herein otherwise specified, of inventions pertaining or applicable 4203 to or to the use of vacuum tubes, and to generating (directly or from other currents), modifying, amplifying, transmitting or receiving electro-magnetic waves, variations or impulses for other than power purposes.

ARTICLE VI.

Provisions with Reference to Foregoing Licenses.

11. Whenever licenses granted under the terms of this agreement are based upon rights held by

the licensor under any agreement requiring the payment of royalties or other deferred payments, measured by the use made of the invention, the party accepting such licenses shall make payments measured by its use of the invention at the same rate and upon the same terms as those agreed to be made by the party originally acquiring the rights.

2. Upon the termination of this agreement under the provisions of article XIV hereof all licenses herein granted shall, during the terms of the several patents, issued or to be issued, in respect of which such licenses exist at the date of termination, continue unaffected and of the same scope and character, whether exclusive or non-exclusive, herein expressed, so far as the grantor thereof has the right to grant such licenses for such terms; and such licenses shall not be limited by the term of this agreement.

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3. (*a*) The Telephone Company may grant sublicenses under its standard form of license contract (a copy of which is now delivered to the General Company) to such operating companies (but not manufacturing companies) as are now or may from time to time be operating under such form of contract. The provisions of this paragraph (*a*) shall apply to any changed form of license contract provided that, as changed, it grants rights in the fields of the General Company no broader than those granted by the present form.

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(*b*) Each party hereto may grant to its subsidiaries sub-licenses under the licenses granted

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to it herein; provided, however, that each subsidiary to which a sub-license shall be granted (excepting, however, sub-licensees pursuant to paragraph (*a*) of this section 3) shall either have entered into an agreement with its parent company effectively subjecting to this agreement all United States patents then or thereafter during the term of this agreement owned or controlled by it, or have executed to the party hereto other than its parent company an instrument granting to such other party licenses under said patents 4208 co-extensive with the licenses herein granted to such other party. Use by any subsidiary of any sub-license granted under this agreement shall for all purposes of this agreement, including determination of royalties payable hereunder, be deemed to be use by its parent company, and ownership, lease or operation of any telephone or telegraph system or station by any subsidiary shall be deemed to be ownership, lease or operation of such system or station by its parent company for all purposes of this agreement.

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(*c*) In addition to the sub-licensing provided for in the foregoing paragraphs (*a*) and (*b*), each party hereto may assign or grant sub-licenses under any of the rights granted to it hereunder, provided that in each instance the assent of the other party is first obtained.

(*d*) Each party may, subject to the provisions of section 4 of this article VI, sell or lease to any sub-licensee having a sub-license to use granted under the provisions of any of paragraphs (*a*), (*b*), and (*c*) of this section 3, apparatus for the use of such sub-licensee under

such sub-license, notwithstanding that the party granting such sub-license may not be licensed under this agreement generally to sell, lease or otherwise dispose of such apparatus.

(*e*) All sub-licenses granted hereunder shall be subject to all limitations and obligations attaching to the apparatus or system in respect of which sub-licenses are granted, whether under the patents, or under the instruments by which
4211 any party acquired the patents or licenses under them, or under this agreement.

(*f*) No disposition by either party of rights hereunder acquired by it, shall relieve such party of any of its obligations under this agreement, or restrict the rights of the parties hereto in operating under or modifying this agreement.

4. Each party agrees that, so far as it is enabled so to do, it will, in disposing of apparatus embodying inventions pertaining or appli-
4212 cable to vacuum tubes, or to generating, modifying, amplifying, transmitting or receiving electro-magnetic waves, or other apparatus or material the unrestricted sale of which would deprive the other party of rights to which it is entitled hereunder, use such precautions by contracts, leases, restricted licenses or otherwise as may be necessary or advisable in order to prevent its subsidiaries, sub-licensees, customers or others from acquiring (by acquisition of apparatus from it or otherwise) licenses to use the same which the party disposing thereof has no right to grant. In case at any time either party shall claim that apparatus made by the other

and capable of use in fields in which the claimant is exclusively licensed under this agreement, has been sold in an amount exceeding the amount reasonably required for use in fields in which the maker is licensed under this agreement, the parties shall endeavor by agreement to determine whether there has been such excess sales of apparatus and, if so, for what periods and in what quantities and the amount of the royalties payable thereon as hereinafter provided; and if the parties shall be unable to agree upon any of said matters, the dispute shall be settled by arbitration as hereinafter provided. The party making such claim shall, if it shall prove the fact of excess sales, not be required to prove with the definiteness which would be required in a court of law or equity, the amount of such excess sales, but the arbitrators shall estimate such amount as nearly as they can from such evidence as may be furnished by the parties and the amount so estimated shall be deemed to be the amount of such excess sales. Upon any excess apparatus so determined to have been sold the party making such excess sales shall pay to the other party royalties equal to fifty per cent. of the current retail price during the period which such excess apparatus was sold.

5. All royalties payable under any provision of this agreement shall continue to be payable to the ends of the terms of the patents in respect of which such royalties are payable, notwithstanding any termination of this agreement.

6. The admission of validity implied in the acceptance of licenses hereunder is limited to the

field for which such licenses are granted or agreed to be granted.

7. No licenses under foreign patents are now granted or are to be implied; but except as herein otherwise expressly provided the licenses to make, sell, lease or otherwise dispose of, herein granted under United States patents include the right to make, sell, lease, or otherwise dispose of for use abroad in the fields for which such
4217 licenses under United States patents are granted, but not for use abroad in other fields. Each party agrees not to export to any country in which the other party has an affiliated company, apparatus purchased from such other party which such other party could not itself so export, in view of existing contract obligations, after notice of such obligations and without first securing a written waiver thereof.

8. Each party represents that in its best judgment it has no outstanding obligations which
4218 would prevent it from entering into the agreements and from granting the licenses herein expressed. If, however, it is found that there are such conflicting obligations, the present agreement is made subject to the right to fulfil those obligations.

ARTICLE VII.

Interferences.

The parties agree to use reasonable endeavors to settle, without litigation, interferences now pending or which may arise involving inventions within the scope of this agreement.

ARTICLE VIII.

Acquisition of Patent Rights.

Neither party shall acquire from others rights to or under United States patents or inventions, or rights to use secret processes, applicable to the fields of the other party, of such limited character that the other party does not, by the operation of this agreement, receive licenses thereunder of the scope and within the respective fields herein set forth, unless the party 4220
proposing to acquire such rights shall first have given the other party an opportunity to be represented in the negotiations and thereby to acquire rights for its field.

ARTICLE IX.

Co-operation and Exchange of Information.

1. Each party agrees that it will, from time to time during the term of this agreement, freely permit the other to have all information in its possession which it may have a right to dispose 4221
of with reference to its standardized apparatus or methods or processes applicable to the uses of the other party in fields in which such other party is granted licenses hereunder, but any secret process so disclosed shall be maintained in secrecy by the party to whom it is disclosed. Blue prints, etc., shall be furnished at the cost of preparing the same. For the purpose of acquiring such information each party shall at all reasonable times have access (through a reasonably limited number of accredited representatives who are regular employees under obligation to assign inventions to their employers), to the laboratories, factories and wireless stations

of the other, to the end that development work may be expedited and rendered the more effective.

Each party shall, with reference to inventions owned or controlled by it, under which the other party is entitled to rights hereunder and which either party deems to be of sufficient value to justify such action, endeavor to obtain or permit and aid the other to obtain proper patents thereon.

4223 2. Each party shall afford the engineering representatives of the other the fullest possible facilities, consistent with the reasonable operation of the other, for experimenting and for developing and testing apparatus and systems for use in transoceanic telephony, and each shall at all times be given such an opportunity to make such tests, experiments and observations in the transoceanic stations of the other as do not conflict with the service then being rendered by such stations, and each party shall afford to the other such facilities for test, experimentation and ob-
4224 servations on ships as it may be able to extend.

3. In the operation of wireless and carrier-current communication, the parties shall co-operate to the end that interference with the operations of either party, due to the operations of the other, shall be minimized, it being recognized that the available wave lengths are limited.

ARTICLE X.

Purchases as Between Parties.

It is recognized that each party has and will normally continue to have facilities for manu-

facturing certain apparatus or parts thereof which may be required by the other party under its licenses hereunder, and that a duplication of such facilities may be wasteful and uneconomical. Each party agrees that it will upon request manufacture for and sell and deliver to the other, with reasonable business promptness and within its reasonable manufacturing capacity, on receipt of orders from time to time, and at favorable prices not to exceed those charged to others (except subsidiaries and, in the case of the Telephone Company, Companies of the Bell System) purchasing in like quantities for use in the United States, such apparatus and parts as the former is engaged in manufacturing from time to time and as the latter may desire for use under the licenses granted by this agreement. 4226

ARTICLE XI.

Litigation.

1. Each party shall have the exclusive right to bring suits for infringement in the fields in which its licenses are herein expressed as exclusive, joining as plaintiff in any such suit the patent owner or the party which has acquired from the patent owner the right to sue thereunder. 4227

2. Neither party shall bring suit for infringement of patents against the other party, or against the distributors and jobbing houses owned by or affiliated with either party, because of sales by such party, or by its (or its subsidiaries') distributors or jobbing houses, of apparatus made, in the United States, by others

than the parties hereto, it being agreed that the remedy in case of any such infringement shall be only by suit against the manufacturer of those devices; but nothing herein contained shall be construed as the granting of a right to sell infringing apparatus manufactured by others.

3. Each party assigns and transfers to the other all claims and causes of action which it may have against others for infringement in fields in which the licenses herein granted to such assignee are exclusive, together with the right to sue for and collect for its own use all profits and damages arising out of such infringement.

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ARTICLE XII.

Releases.

Each party reserves to itself the right to deal with the United States Government with reference to settlement for past use of its inventions in telephone and telegraph apparatus and systems. Subject to the foregoing, each party releases the other and the vendees and users of apparatus or systems made by it, from all claims growing out of past infringement of patents, by reason of the manufacture, use and sale of such apparatus and systems by the other party, and its resale or use by such vendees and users.

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ARTICLE XIII.

Arbitration.

In case any controversy under this agreement (except in respect of interference or priority of rights to inventions or patents) shall arise between the parties to this agreement, which they

are unable to adjust between themselves, it shall be settled by arbitration pursuant to the Arbitration Law of the State of New York in the following manner:

Either party may by notice in writing served on the other, appoint one arbitrator and call upon the other to appoint a second arbitrator within thirty days after the receipt of such notice; and each party agrees that upon receiving any such notice it will so appoint an arbitrator. The two arbitrators thus appointed shall, 4232 within thirty days after the appointment of the one last appointed, jointly appoint a third arbitrator. The controversy shall be submitted to the three arbitrators in such manner as they shall direct and their decision, or the decision of a majority of them, rendered in writing, shall be final, conclusive and binding upon the parties. In the event that a second arbitrator shall not be appointed as above provided or the two arbitrators first appointed shall fail to appoint a third, application may be made by either party to the Supreme Court of the State of New York, 4233 or to a judge thereof, to designate and appoint an arbitrator or arbitrators, as the case may require, as provided by said Arbitration Law. Each party shall pay its own expenses in connection with the arbitration but the compensation and expenses of the arbitrators shall be borne in such manner as may be specified in their decision in writing.

ARTICLE XIV.

Termination of Agreement.

This agreement shall continue until July 1, 1933, but shall automatically continue thereafter

until cancelled on three years' written notice given after July 1, 1930, by one party to the other party.

ARTICLE XV.

Further Assurances.

The parties agree to execute and deliver such further instruments as may reasonably be necessary for carrying out the provisions and pur-
4235 poses of this agreement.

ARTICLE XVI.

Successors.

This agreement is binding upon and shall inure to the benefit of each of the parties hereto and their several successors in business, except that either party may transfer or dispose of any part or parts of its business not involving the grant of any licenses under this agreement, and in such case this agreement shall not be binding
4236 upon or inure to the benefit of the successors to that part of the business so transferred.

In witness whereof, the parties hereto have caused this instrument to be executed on the day and year first above written, by their proper officers thereunto duly authorized.

General Electric Company,
By E. W. Rice, Jr.,
President.

[seal]

Attest:

J. W. Elwood,
Assitant Secretary.

Defendant's Exhibit D.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
By H. B. THAYER,
President.

[SEAL]

Attest:

A. A. MARSTERS,
Secretary.

II. The foregoing modifications shall be effective from and after the date of this agreement.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed as of the day and year first above written, by their proper officers thereunto duly authorized.

GENERAL ELECTRIC COMPANY,
By OWEN D. YOUNG,
Chairman of the Board.

[SEAL OF GENERAL ELECTRIC COMPANY]

Attest:

J. W. LEWIS,
Assistant Secretary.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
By D. F. HOUSTON,
Vice-President.

[SEAL OF AMERICAN TELEPHONE AND TELEGRAPH COMPANY]

Attest:

A. A. MARSTERS,
Secretary.

4240

Defendant's Exhibit E.

LICENSE AGREEMENT

(Power Supply & Amplifier Units)

BETWEEN

RADIO CORPORATION OF AMERICA, GENERAL ELECTRIC COMPANY and WESTINGHOUSE ELECTRIC &
4241 MANUFACTURING COMPANY

AND

AMERICAN TRANSFORMER CO.

1927.

LICENSE AGREEMENT

LICENSE AGREEMENT as of February 1st, 1927, by and between RADIO CORPORATION OF
4242 AMERICA, hereinafter termed Radio Corporation, GENERAL ELECTRIC COMPANY, and WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, hereinafter termed Licensors, and AMERICAN TRANSFORMER CO., a corporation of the State of N. J., hereinafter termed Licensee,

WITNESSETH:

THAT WHEREAS the Licensors represent that they severally own and/or have the right to grant licenses under various United States Let-

ters Patent relating to Power Supply and to Power Amplifier Units, hereinafter termed Licensed Apparatus, and

WHEREAS the Licensee desires to make lawful use of some or all of the inventions covered by said Letters Patent of the United States, and to that end desires to acquire the licenses herein expressed;

NOW, THEREFORE, in consideration of the premises, the licenses granted herein by the Licensors to the Licensee, and the covenants herein contained, it is agreed that: 4244

1. Each of the Licensors hereby grants under all of the United States Patent useful in the Licensed Apparatus, owned by it and/or with respect to which it has the right to grant licenses, during the term of this Agreement or until it is sooner terminated as hereinafter provided for, and upon the terms and conditions hereinafter set forth, and solely and only to the extent and for the uses hereinafter specified and defined, a personal, indivisible, non-transferable and non-exclusive license to the Licensee to manufacture at its factory located at 174-188 Emmet St., Newark, in the State of N. J.; and not elsewhere without previous written permission obtained from the Radio Corporation, and to sell only for radio amateur reception, radio experimental reception, and radio broadcast reception throughout the United States and its territories or dependencies, Licensed Apparatus so manufactured by the Licensee, except that no license is granted in this Agreement under any Letters Patent with 4245

respect to which a Licensor has the right to grant licenses only upon condition of royalty or other consideration by said Licensor or its sublicensee.

Nothing herein contained shall be regarded as conferring upon the Licensee, either expressly or by estoppel, implication, or otherwise, a license to manufacture or sell any apparatus except such as may be manufactured by the Licensee in accordance with the express provisions of this
4247 Agreement. Nothing herein contained shall be construed as conveying any license expressly or by implication, estoppel or otherwise under any patents of countries foreign to the United States.

2. (*a*) That the term "amateur reception", for the purpose of this Agreement, means reception by one not a professional investigator who is more than a mere broadcast listener, and who evidences his interest in the art of wireless telephony by study, investigation, or experiment in the art.

4248

(*b*) That the term "experimental reception", for the purposes of this Agreement, means the use in a laboratory, college, school or scientific society or in professional investigations, but not in any case reception of messages, directly or indirectly for business purposes.

(*c*) That the term "broadcast reception", for the purpose of this Agreement, is defined as follows: The reception from radio telephone broadcast stations of news, music, speeches, sermons, advertising, and entertainments, educational and similar matter, or any of them, or combinations

of any of them, for the purpose of exhibition, entertainment or instruction.

3. The Licensee hereby agrees to pay to the Radio Corporation a royalty of seven and one-half per cent. (7½%) on the Licensee's net selling price of the Licensed Apparatus manufactured and sold by it during the continuance of this Agreement, except that no royalty shall be paid on, and no reports are required with reference to sales of apparatus purchased from or 4250
through the Radio Corporation. That for the purpose of this Agreement all Licensed Apparatus shall be considered as "sold" when the Licensed Apparatus has been billed out, or if not billed out, when it has been delivered, shipped, or mailed.

4. The Licensee within thirty (30) days after, and as of, the first days of January, April, July and October in each year respectively (hereinafter referred to as "Quarter Days"), shall furnish the Radio Corporation with written state- 4251
ments, under oath, specifying exactly the total number of Licensed Apparatus sold or otherwise disposed of under this Agreement by the Licensee during the preceding quarter. Said statements shall show the Licensee's net selling price with respect to all such Licensed Apparatus; the date when each was sold or otherwise disposed of, and the trade or brand name. The first of such statements shall be rendered not later than the fifteenth day after the Quarter Day next following the date of this Agreement, as of such Quarter Day and shall cover the period from the date of this Agreement to said Quarter Day.

4252 *Defendant's Exhibit E.*

The royalty prescribed herein shall be due and payable on the 30th days of January, April, July and October of each year upon all such Licensed Apparatus sold or otherwise disposed of by the Licensee during the preceding quarter, or in the case of the first statement, the period covered thereby. The Licensee shall keep true, accurate and separate books of account containing all the information required to be given in the statements provided for in the preceding clause, and
4253 shall permit the Radio Corporation or its duly authorized agents or attorneys, at any time during the usual business hours, to inspect the same.

5. The Licensee shall affix to all Licensed Apparatus manufactured and sold by the Licensee under the terms of this Agreement, a license plate reading: "Licensed only for Radio Amateur, Experimental and Broadcast Reception" and the word "Patented", and giving the dates of the patents and which are, in the opinion of the Radio Corporation, used in such Licensed
4254 Apparatus. The Licensee further agrees that any and all catalogs, circulars or price lists, or general advertising, of the Licensee, shall contain a statement to the effect that the Licensed Apparatus so manufactured and sold by the Licensee, is "Licensed only for Radio Amateur, Experimental and Broadcast Reception", and that all such catalogs, circulars, or price lists, or general advertising, shall be subject to the approval of the Radio Corporation with respect to any reference to the Licensors or any of them, or to any matters relating to this Agreement.

6. In the event of the failure by the Licensee at any time during the continuance in force of

this Agreement to render any of the statements called for herein upon any of the prescribed dates, or to pay all the royalties required hereunder when due; or to comply with any of the other obligations of this Agreement, it is understood and agreed that should the Licensee refuse or neglect so to do for thirty (30) days after notification from the Radio Corporation by registered mail to the last known place of business of the Licensee, of the Licensee's failure in any of these respects, this Agreement shall cease 4256
and terminate, at the option of the Licensor, thirty (30) days after notice in writing by registered mail to that effect has been forwarded to the Licensee, but no such cancellation shall release the Licensee from any of the liabilities accruing to the Licensor hereunder prior to the time such cancellation becomes effective. No failure on the part of the Radio Corporation to exercise its right of cancellation hereunder for any one or more defaults or breaches of covenant shall be construed to prejudice its right of cancellation for any subsequent default or breach 4257
of covenant. Bankruptcy of the Licensee shall terminate this Agreement, and the Radio Corporation shall also have the right to terminate it upon the insolvency of the Licensee or the appointment of a receiver for its property.

7. Neither this Agreement or any of its benefits shall be directly or indirectly assigned, transferred, divided or shared by the Licensee with any person, firm, or corporation whatsoever, without the written consent of the Radio Corporation, but this Agreement shall inure to the benefit of the successor or assigns of the several

Licensors, but shall not inure to the benefit of the successors, assigns, or any legal representatives of the Licensee, without the consent of the Radio Corporation in writing having first been obtained.

8. Nothing herein contained shall be construed as conveying any licenses expressly or by implication, estoppel or otherwise to manufacture, use or sell vacuum tubes, except to use and sell the
4259 vacuum tubes purchased from the Radio Corporation as provided herein. The Radio Corporation hereby agrees to sell to the Licensee and the Licensee hereby agrees to purchase from the Radio Corporation the number, and only the number, of vacuum tubes to be used as parts of the circuits licensed hereunder and required to make initially operative the Licensed Apparatus such tubes to be sold by the Radio Corporation to the Licensee at the terms and at the prices at which they are then being sold by the Radio Corporation to other manufac-
4260 turers of the Licensed Apparatus buying in like quantities for the same purposes. But the sale of such tubes by the Radio Corporation to the Licensee shall not be construed as granting any licenses except the right to sell such tubes for use in, and to use them in, the Licensed Apparatus made and sold hereunder.

9. The Licensors or any of them or the American Telephone & Telegraph Company shall have the right to acquire for itself or for any corporation or corporations controlled by any of them through stock ownership of more than fifty per cent. of its issued stock, one or more

non-exclusive license or licenses on reasonable terms under any United States Letters Patent owned by the Licensee or under which it may have the right to grant a license or licenses. The terms of such license or licenses shall not be less favorable to the licensed party or parties than any other similar license from the Licensee, and such license or licenses shall remain in full force and effect during the term of this Agreement. If the terms of such license or licenses cannot be agreed upon, then such 4262
terms shall be settled by arbitration pursuant to the Arbitration Law of the State of New York. The Licensee may terminate such right with respect to any Licensor and/or its controlled corporations as above defined and with respect to any specified Letters Patent by serving written notice upon any Licensor that unless said Licensor shall advise the Licensee in writing within six months of its intention to exercise said right with respect to Letters Patent specified in said notice, such right shall then terminate at the end of such six months' period. 4263

10. The Licensors shall have the right to terminate this Agreement by the Radio Corporation giving written notice to the Licensee that this Agreement shall terminate one year from the date of such written notice, and this Agreement and all licenses thereunder shall thereupon terminate upon the date specified in said notice. The term of this Agreement shall be four and one-half (4½) years from February 1, 1927, unless sooner terminated, as hereinbefore provided. The termination of this Agreement, either four and one-half years from date or sooner,

shall not release the Licensee from any of its liabilities accruing prior to such termination.

IN WITNESS WHEREOF, the parties hereto have caused these presents to be executed by their proper officers thereunto duly authorized, and their corporate seals to be hereunto affixed, the day and year first above written.

RADIO CORPORATION OF AMERICA
By (Sgd.) DAVID SARNOFF
4265 Vice President.

(Seal)

Attest

(Sgd.) L. MACCONNACH
Secretary

GENERAL ELECTRIC COMPANY
By (Sgd.) GERARD SWOPE
President.

(Seal)

Attest

4266

(Sgd.) J. W. LEWIS
Asst. Secretary

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
By (Sgd.) CHARLES A. TERRY
Vice President.

(Seal)

Attest

(Sgd.) WARREN H. JONES
Asst. Secretary

Defendant's Exhibit E. 4267

AMERICAN TRANSFORMER Co.
By (Sgd.) W. F. HUBLEY
President.

(Seal)

Attest

(Sgd.) M. H. HARROLD
Secretary

In consideration of the obligations contained in paragraph 9 of the foregoing Agreement, the American Telephone and Telegraph Company joins in and assents to the grant of the licenses hereinbefore granted by the Licensors. 4268

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
By (Sgd.) W. S. GIFFORD
President.

(Seal)

Attest

(Sgd.) A. A. MARSTERS
Secretary 4269

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DEFENDANT'S EXHIBIT F

1421

No. 841,387. PATENTED JAN. 15, 1907.

L. DE FOREST.

DEVICE FOR AMPLIFYING FEEBLE ELECTRICAL CURRENTS.

APPLICATION FILED OCT. 25, 1906.

2 SHEET—SHEET 1.

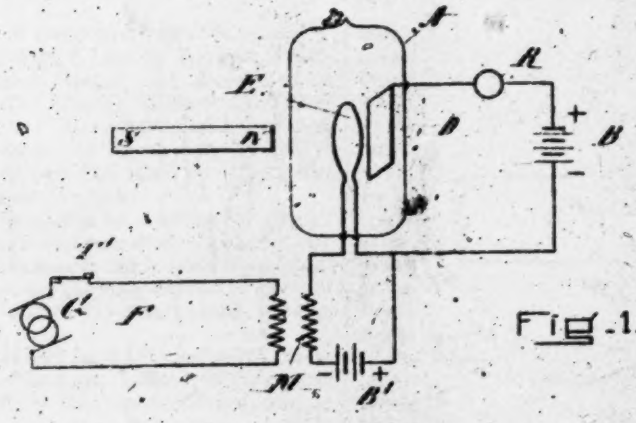


Fig. 1.

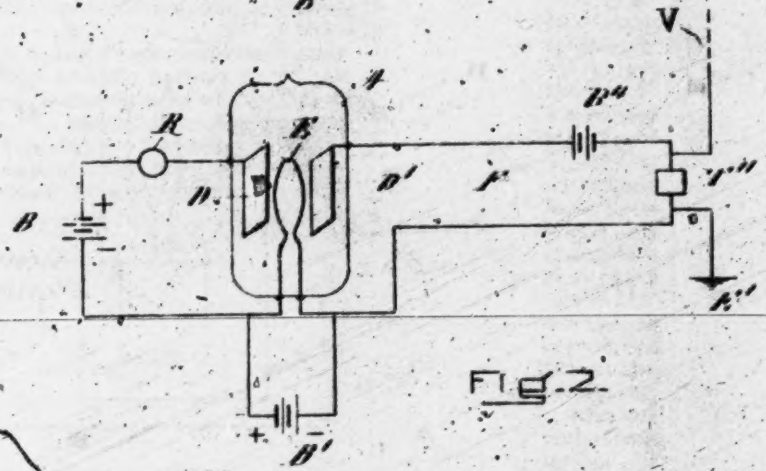


Fig. 2.

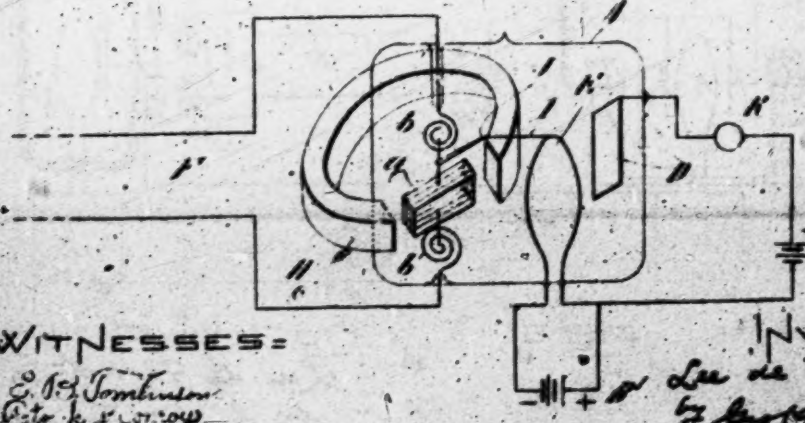


Fig. 3.

WITNESSES:

E. F. Tomlinson

Peter L. Corroy

INVENTOR:

Lee de Forest

by Brock & Wentworth

attorneys

1425

No. 841,387. PATENTED JAN. 15, 1907.

L. DE FOREST.

DEVICE FOR AMPLIFYING FEEBLE ELECTRICAL CURRENTS.

APPLICATION FILED OCT. 25, 1906.

2 SHEETS—SHEET 2.

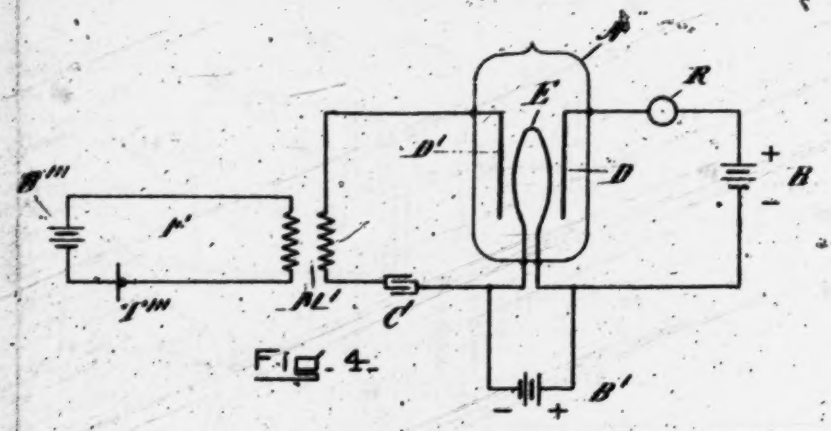


Fig. 4.

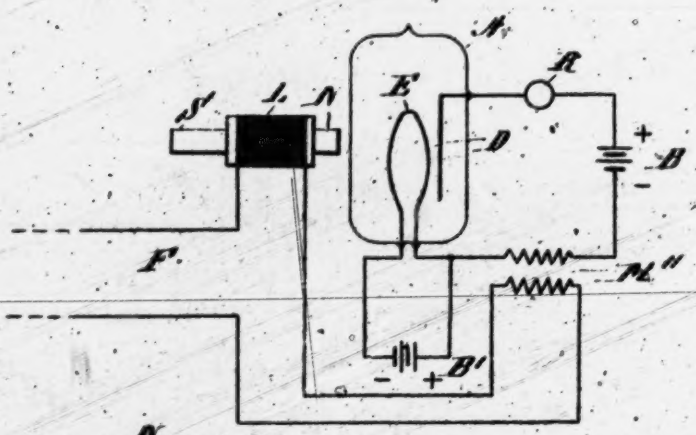


Fig. 5.

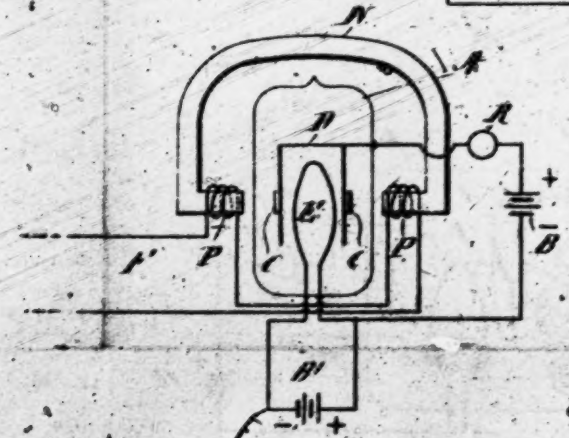


Fig. 6.

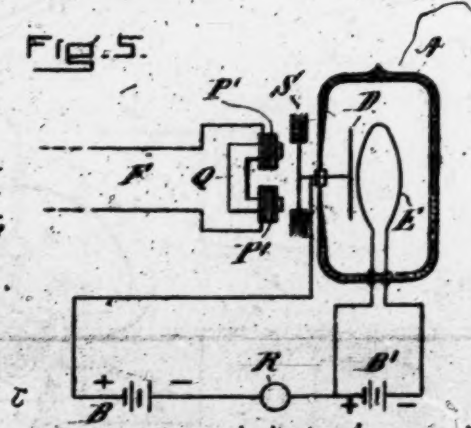


Fig. 7.

WITNESSES:
E. B. Tomlinson
Edmund J. Lowry

INVENTOR
Lee de Forest
by Geo. H. Woodworth
Attorney

UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y.

DEVICE FOR AMPLIFYING FEEBLE ELECTRICAL CURRENTS.

No. 841,387. Specification of Letters Patent. Patented Jan. 15, 1907.

Application filed October 25, 1906. Serial No. 340,527.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Devices for Amplifying Feeble Electrical Currents, of which the following is a specification.

My invention relates to devices for amplifying feeble electrical currents—such, for example, as telephone-currents; and its object is to produce an amplifying device of greater efficiency and simplicity than those heretofore employed.

My invention will be described with reference to the drawings accompanying and forming a part of this specification, and in which—

Figures 1, 2, 3, 4, 5, 6, and 7 represent conventionally or diagrammatically various arrangements of apparatus and circuits whereby my invention may be carried into effect.

In the figures, A represents an evacuated vessel inclosing a sensitive conducting gaseous medium maintained in a condition of molecular activity.

R is a signal-indicating device.

B B are batteries or other sources of electrical energy.

D E D′ are electrodes sealed within the receptacle A.

The circuit B R D E is a local receiving-circuit. The circuit F is a line-circuit conveying the currents to be amplified to the amplifying device. The electrode E, which may be of platinum, tantalum, carbon, or other suitable material, is heated and preferably maintained incandescent by the battery B′. The electrodes D and D′, which may be plates of platinum or other suitable material, are placed in close proximity to the electrode E, and when the electrode D′ is employed its separation from the electrode E preferably is less than that of the electrode D therefrom.

In Fig. 1, N S represent a magnet placed adjacent to the vessel A. The currents to be amplified may be impressed upon the circuit which includes the heated electrode or filament E—as, for example, by means of the transformer M—and the magnetic field set up by these currents reacts upon the field set up by the magnet N S, thereby causing a slight variation in the separation between the electrodes D E. I have found that the slightest variation in the separation of the hot and cold electrodes produces a large and disproportionately greater variation in the flux between said electrodes, especially if the latter are close together, and such variation in flux may be made manifest by the signal-indicating device R.

In Fig. 2 the current to be amplified may be impressed upon the medium intervening between the electrodes D and E, and thereby alter, by electrostatic attraction, the separation between the electrodes. In this case D′ may be a strip of platinum-foil, and the slightest approach thereof toward the filament will act to slightly cool the gaseous medium, and thereby alter the current in the local circuit, or, if D′ is rigid, the increase in electrostatic attraction between D′ and E will cause E to recede from D, and thereby alter the current in the local circuit.

In Fig. 3 the filament E is connected, by means of a minute platinum wire I, to the arm J which is secured to the coil a, placed between the poles of the magnet H and secured to the walls of the vessel A through the spiral springs b b. The line-current to be amplified in this case is passed through the coil a through the springs b b, and the resulting rotation of the coil varies the separation between the electrodes D E, thereby altering the current in the local circuit.

In Fig. 4 the currents to be amplified may be impressed upon the gaseous medium intervening between D′ and E by means of the transformer M′. A condenser C may be included in series with the secondary of said transformer and the electrodes D′ E. In this case there may or may not be a variation between the separation of the electrodes, and the currents to be amplified may vary the motions of the ions around the filament, thereby controlling to a greater degree the flux between said filament and the electrode D.

In Fig. 5 the currents to be amplified may be passed through the solenoid surrounding the magnet N S, and thereby vary the field, which by reacting with the magnetic field surrounding the electrode E determines the normal separation of the electrodes D and E. Even without creating actual movements between the electrodes D and E the varying magnetic flux produced by the line-current passing through the solenoid L will affect the motion of the ions in the gaseous medium, and thereby alter the current in the local circuit.

In Fig. 6 the electrode D may be consti-

tuted of iron or may consist of platinum plates provided with small iron armatures O O. In either case the currents to be amplified by passing through the solenoids P P, which surround the poles of the magnet N, effect the desired variation in the separation of the electrodes D and E.

In Fig. 7 the electrode D and diaphragm S may both be rigidly secured to the inside and outside, respectively, of the glass wall of the vessel A at a point where said wall has been flattened and made very thin, like the crystal of a watch. The currents to be amplified in this case by operating upon the coils P' P', surrounding the magnet Q, effect slight movements of the diaphragm S, and these movements are mechanically transmitted through the glass wall of the vessel A to the electrode D, thereby varying the current in the local receiving-circuit.

It will be obvious that the amplifying device, which constitutes the subject-matter of the present invention, is not limited in its use to any particular kind of electrical circuit or apparatus, but that it is capable of general application wherever an amplifying device is required. By way of example of its application to a wire telegraph or cable system I have shown the line F in Fig. 1 as including a telegraph transmitting-key T' and source of vibratory current G. In Fig. 2 I have shown the line F as constituting the local circuit of a wireless-telegraph receiving system including the battery B'' and oscillation-detector T'', the latter being connected in series with an antenna V and the earth E'. In Fig. 4 I have shown the line F as constituting a telephone-circuit including the microphone-transmitter T''' and battery B'''. In all instances it will be understood by those skilled in the art and without going into further detail that the signal-indicating device R, which is included in the local receiving-circuit, may be any device suitable for the purpose of reproducing the signal initiated in the line F.

I do not limit myself to any of the specific embodiments of my invention herein described, inasmuch as many modifications will readily occur to those skilled in the art without departing from the principle of my invention.

I claim—

1. In a device for amplifying electrical currents, an evacuated vessel inclosing a sensitive conducting gaseous medium maintained in a condition of molecular activity, two electrodes sealed within said vessel, a local receiving-circuit associated with said electrodes, and means whereby the separation of said electrodes may be varied by the current to be amplified.

2. In a device for amplifying electrical currents, an evacuated vessel, two electrodes sealed within said vessel, means for heating one of said electrodes, a local receiving-circuit associated with said electrodes, and means whereby the separation of said electrodes may be varied by the currents to be amplified.

3. In a device for amplifying electrical currents, an evacuated vessel, two electrodes sealed within said vessel, a circuit including a source of electric energy connected in series with one of said electrodes, a local receiving-circuit associated with said electrodes and means whereby the separation of said electrodes may be varied by the currents to be amplified.

4. In a device for amplifying electrical currents, an evacuated vessel, three electrodes sealed within said vessel, means for heating one of said electrodes, a local receiving-circuit including two of said electrodes, and means for passing the current to be amplified between one of the electrodes which is included in the receiving-circuit and the third electrode.

5. In a device for amplifying electrical currents, an evacuated vessel inclosing a gaseous medium, means other than the received energy for maintaining said gaseous medium in a condition of molecular activity, means for impressing the currents to be amplified upon said gaseous medium, and a local receiving-circuit having electrodes sealed within said vessel.

6. In a device for amplifying electrical currents, an evacuated vessel, a heated electrode and two non-heated electrodes sealed within said vessel, the non-heated electrodes being unequally spaced with respect to said heated electrode, a local receiving-circuit including said heated electrode and that one of the non-heated electrodes which has the greater separation from the heated electrode, and means for passing the current to be amplified between the heated electrode and the other non-heated electrode.

In testimony whereof I have hereunto subscribed my name this 17th day of October, 1906.

LEE DE FOREST

Witnesses:
RALPH POLK BUELL,
SIDNEY WILLIAMS

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PAGE

1428

No. 879,532. PATENTED FEB. 18, 1908.

L. DE FOREST.

SPACE TELEGRAPHY.

APPLICATION FILED JAN. 29, 1907.

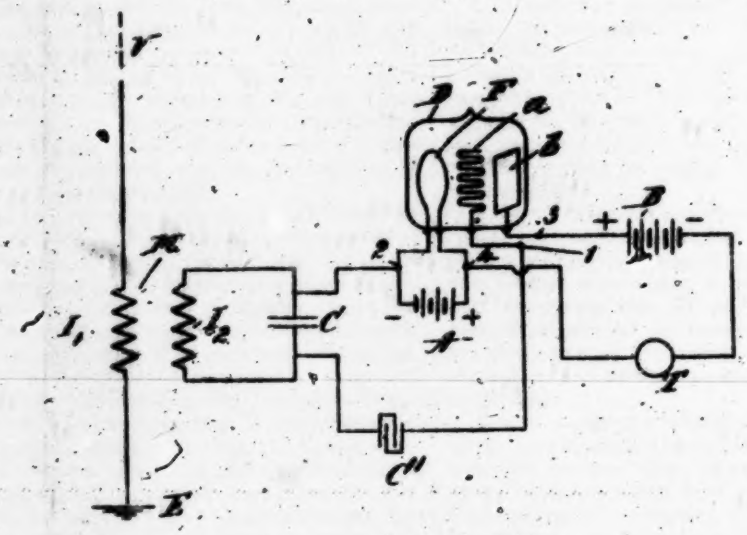


Fig. 1.

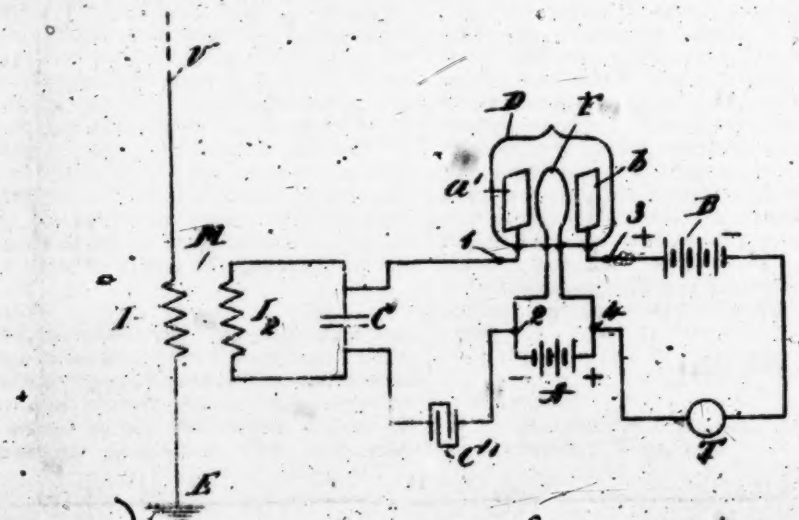


Fig. 2.

WITNESSES:
E. W. Sturgiss
Edward J. Cooney

INVENTOR:
Lee de Forest
by Geo. K. Woodworth
Atty.

UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO DE FOREST RADIO TELEPHONE CO., A CORPORATION OF NEW YORK.

SPACE TELEGRAPHY.

No. 879,532. Specification of Letters Patent. Patented Feb. 18, 1908.

Application filed January 22, 1907. Serial No. 353,042.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Space Telegraphy, of which the following is a specification.

My invention relates to wireless telegraph receivers or oscillation detectors of a type heretofore described in my prior Letters Patent Nos. 824,637, June 26, 1906 and 836,070, November 13, 1906.

The objects of my invention are to increase the sensitiveness of oscillation detectors comprising in their construction a gaseous medium by means of the structural features and circuit arrangements which are hereinafter more fully described.

My invention will be described with reference to the drawings which accompany and form a part of the present specification, although it is to be understood that many modifications may be made in the apparatus and systems herein described without departing from the principles of my invention.

In the drawings, Figure 1 represents in diagram a wireless telegraph receiving system comprising an oscillation detector constructed and connected in accordance with the present invention and Fig. 2 represents a space telegraph receiving system having a modified form of oscillation detector connected therein in a manner which constitutes one of the subjects matter of said invention.

V I, E is an elevated conductor system including the elevated conductor V, earth connection E, and primary I, of the transformer M, the secondary I, of which forms part of the tuned receiving circuit I, C. It will be understood of course that the aforesaid tuned receiving circuit may be associated with the elevated conductor system in any suitable manner.

D represents an evacuated vessel, preferably of glass, having sealed therein three conducting members, F, *a* and *b*, in Fig. 1 and F, *a'* and *b* in Fig. 2. The conducting member or electrode F is shown as consisting of a filament, preferably of metal, which is connected in series with the battery A or other source of electrical current of sufficient strength to heat said filament, preferably to incandescence. The conducting member *b*, which may be a plate of platinum, has one end brought out to the terminal 3. Interposed between the members F and *b* is a grid-shaped member *a*, which may be formed of platinum wire, and which has one end brought out to the terminal 1. The local receiving circuit, which includes the battery B, or other suitable source of electromotive force, and the signal indicating device T, which may be a telephone receiver, has its terminals connected to the plate *b* and filament F at the points 3 and 4 respectively. The means for conveying the oscillations to be detected to the oscillation-detector, are the conductors which connect the filament F and grid *a* to the tuned receiving circuit and, as shown, said conductors pass from the terminals 2 and 1 to the armatures of the condenser C.

I have determined experimentally that the presence of the conducting member *a*, which as before stated may be grid-shaped, increases the sensitiveness of the oscillation detector and, inasmuch as the explanation of this phenomenon is exceedingly complex and at best would be merely tentative, I do not deem it necessary herein to enter into a detailed statement of what I believe to be the probable explanation.

In associating an oscillation detector of the above mentioned type, said detector being now commonly known as the audion, with a closed tuned circuit, it will be noted by reference to Fig. 2, that the secondary I, closes a circuit containing a battery shown at B through the electrode *b*, conducting member *a'* and the conducting gaseous medium intervening between said electrode and member. Also by reference to Fig. 1, it will be seen that a similar closed circuit exists between said battery, and the electrode *b* and conducting member *a*. In order to close each of said circuits to the passage of direct current from the aforesaid battery therethrough, or to prevent the development of a difference of potential between the members *a* and *b*, or between *a'* and *b*, or to prevent the members *a* or *a'* from receiving an electrical charge from said battery, I insert the condenser C in said otherwise mechanically closed circuit and find that the presence of said condenser produces a great increase in the sensitiveness of the oscillation detector as determined by the very marked increase in the sound produced in the telephone T

when said condenser is present over the sounds produced therein under the same conditions when said condenser is not employed.

It will be understood that the circuit arrangements herein described with reference to the particular forms of audion herein disclosed may with advantage also be employed with various other types of audion.

I claim:

1. An oscillation detector comprising an evacuated vessel, an electrode inclosed therein, means for heating said electrode, a second electrode inclosed within said vessel, a local circuit having its terminals electrically connected to said electrodes, a conducting member inclosed within said vessel and located between said electrodes, and means for conveying the oscillations to be detected to the first mentioned electrode and said conducting member.

2. An oscillation detector comprising an evacuated vessel, two electrodes inclosed within said vessel, means for heating one of said electrodes, and a conducting member inclosed within said vessel and interposed between said electrodes.

3. An oscillation detector comprising an evacuated vessel, two electrodes inclosed within said vessel, means for heating one of said electrodes, and a grid-shaped member of conducting material inclosed within said vessel and interposed between said electrodes.

4. An oscillation detector comprising an evacuated vessel, a filament sealed therein, a source of electrical energy connected in series with said filament, an electrode sealed in said vessel, a local circuit having its terminals connected to said filament and electrode, respectively, said local circuit including a source of electromotive force and a signal indicating device, a grid of conducting material sealed in said vessel and interposed between said filament and electrode, and means for conveying the oscillations to be detected to said filament and grid.

5. An oscillation detector comprising an evacuated vessel, an electrode inclosed therein, means for heating said electrode, a second electrode inclosed within said vessel, a local circuit having its terminals connected to said electrodes, a conducting member inclosed within said vessel and located between said electrodes, a closed circuit for conveying the oscillations to be detected to said first mentioned electrode and conducting member, and a condenser in said closed circuit.

6. An oscillation detector comprising an evacuated vessel, two electrodes inclosed therein, means for heating one of said electrodes, a conducting member inclosed within said vessel and interposed between said electrodes, means for establishing a difference of electrical potential between said electrodes and means for preventing said conducting member from becoming electrically charged.

7. An oscillation detector comprising an evacuated vessel inclosing a sensitive conducting gaseous medium, three conducting members inclosed therein, a closed oscillation circuit, a circuit connecting an element of said oscillation circuit with two of said members, a condenser in said circuit, a signal-indicating device, and a circuit connecting said device with one of said two members and with the third member.

8. An oscillation detector comprising an evacuated vessel, two electrodes inclosed therein, means for heating one of said electrodes, a conducting member inclosed within said vessel and interposed between said electrodes, means for establishing a difference of electrical potential between said electrodes and means for preventing the establishment of a difference of electrical potential between one of said electrodes and said conducting member.

9. An oscillation detector comprising an evacuated vessel, two electrodes inclosed therein, means for heating one of said electrodes, a grid of conducting material inclosed within said vessel and interposed between said electrodes, means for establishing a difference of electrical potential between said electrodes and means for preventing said grid from becoming electrically charged.

10. An oscillation detector comprising an evacuated vessel, two electrodes inclosed therein, means for heating one of said electrodes, a grid of conducting material inclosed within said vessel and interposed between said electrodes, means for establishing a difference of electrical potential between said electrodes and means for preventing the establishment of a difference of electrical potential between one of said electrodes and said grid.

11. An oscillation detector comprising an evacuated vessel, an electrode inclosed therein, means for heating said electrode, a second electrode inclosed within said vessel, a local circuit having its terminals electrically connected to said electrodes, a grid of conducting material inclosed within said vessel and located between said electrodes, and means for conveying the oscillations to be detected to the heated electrode and grid.

12. An oscillation detector comprising an evacuated vessel, an electrode inclosed therein, means for heating said electrode, a second electrode inclosed within said vessel, a local circuit having its terminals connected to said electrodes, a grid of conducting material inclosed within said vessel and located between said electrodes, a closed circuit for conveying the oscillations to be detected to the heated electrode and grid, and a condenser in said closed circuit.

13. An oscillation detector comprising an

evacuated vessel, an electrode inclosed therein, means for heating said electrode, a second electrode inclosed within said vessel, a local circuit having its terminals electrically connected to said electrodes, said local circuit including a source of electromotive force and a signal indicating device, a grid of conducting material inclosed within said vessel and located between said electrodes, and means for conveying the oscillations to be detected to the heated electrode and grid.

14. An oscillation detector comprising an evacuated vessel, two electrodes, one of which is a filament, inclosed within said vessel, means for heating said filament, and a conducting member inclosed within said vessel and interposed between said electrodes.

15. An oscillation detector comprising an evacuated vessel, two electrodes inclosed within said vessel, means for heating one of said electrodes, a grid of conducting material inclosed within said vessel and interposed between said electrodes, a local circuit connecting said electrodes, and a source of electromotive force and signal indicating device in said local circuit.

16. An oscillation detector comprising an evacuated vessel, two electrodes, one of which is a filament, inclosed within said vessel, means for heating said filament, and a grid of conducting material inclosed within said vessel and interposed between said electrodes.

17. An oscillation detector comprising an evacuated vessel, two electrodes inclosed within said vessel, means for heating one of said electrodes, a conducting member inclosed within said vessel and interposed between said electrodes, and a local circuit including a source of electromotive force connecting said electrodes.

18. An oscillation detector comprising an evacuated vessel, two electrodes inclosed within said vessel, means for heating one of said electrodes, a grid of conducting material inclosed within said vessel and interposed between said electrodes, a local circuit including a source of electromotive force connecting said electrodes and a signal indicating device associated with said local circuit.

19. An oscillation detector comprising an evacuated vessel, two electrodes, one of which is a filament, inclosed within said vessel, means for heating said filament, a grid of conducting material inclosed within said vessel and interposed between said electrodes and a local circuit including a source of electromotive force connecting said electrodes.

20. An oscillation detector comprising an evacuated vessel, two electrodes inclosed therein, means for heating one of said electrodes, a conducting member inclosed within said vessel, a closed oscillation circuit, a circuit connecting one element of said oscillation circuit with one of said electrodes and said conducting member, and a condenser in said circuit.

21. An oscillation detector comprising an evacuated vessel, two electrodes inclosed therein, means for heating one of said electrodes, a conducting member inclosed within said vessel, a closed oscillation circuit, a circuit connecting one element of said oscillation circuit with one of said electrodes and said conducting member, a condenser in said circuit, a signal indicating device and a circuit connecting said device with the other of said electrodes and said conducting member.

In testimony whereof, I have hereunto subscribed my name this 21st day of Dec. 1906.

LEE DE FOREST.

Witnesses:

THOMAS I. GALLAGHER,

HANS W. GOETER.

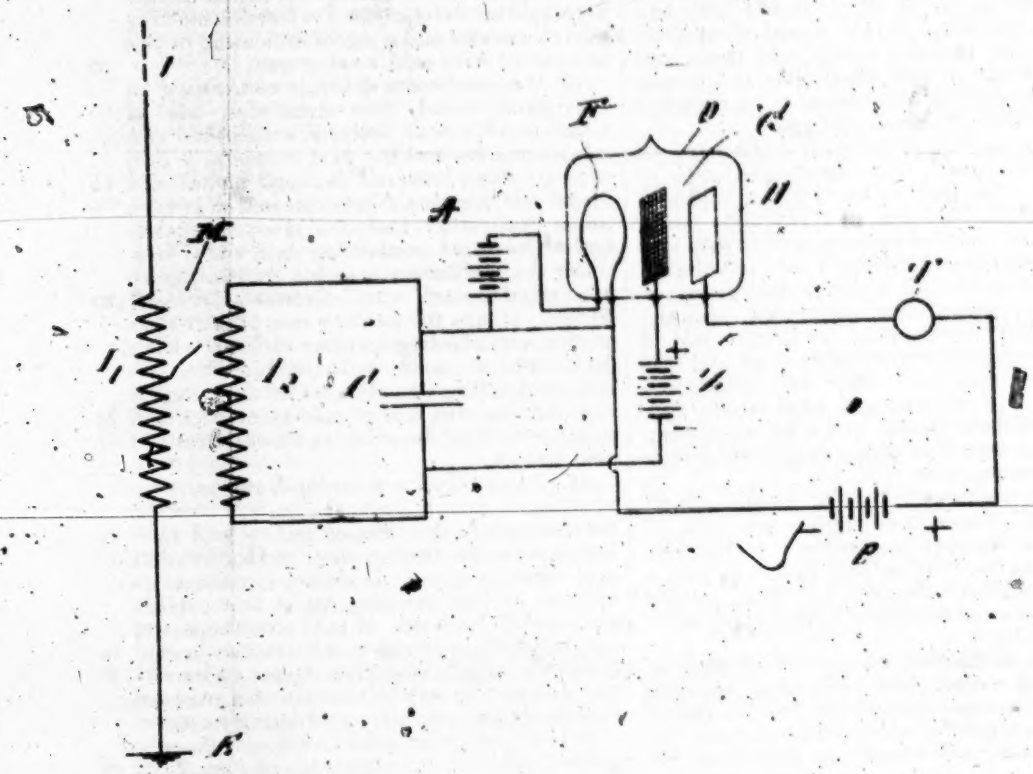
1432

No. 884,110. PATENTED APR. 7, 1908.

J. S. STONE & S. CABOT.

SPACE TELEGRAPHY.

APPLICATION FILED JAN. 4, 1907.



WITNESSES:

E. B. Tomlinson

Patrick J. Conroy

INVENTORS

John Stone Stone

Samuel Cabot

by Brownell & Woodworth

Attys.

UNITED STATES PATENT OFFICE.

JOHN STONE STONE, OF BOSTON, AND SEWALL CABOT, OF BROOKLINE, MASSACHUSETTS, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO WILLIAM W. SWAN, TRUSTEE, OF BROOKLINE, MASSACHUSETTS.

SPACE TELEGRAPHY.

No. 884,110. Specification of Letters Patent. Patented April 7, 1908.

Application filed January 4, 1907. Serial No. 350,721.

To all whom it may concern:

Be it known that we, JOHN STONE STONE and SEWALL CABOT, citizens of the United States, and residents respectively, of Boston and Brookline, in the counties of Suffolk and Norfolk and State of Massachusetts, have invented a new and useful Improvement in Space Telegraphy, of which the following is a specification.

Our invention relates to oscillation detectors for space-telegraph receiving systems, and more especially to the particular oscillation detector known as the audion, a device which is now well known and which has been fully described in a paper by Dr. Lee de Forest published in the *Proceedings of the American Institute of Electrical Engineers*, October, 1906, p. 719, to which reference may be had for a more detailed description thereof than is necessary to set forth herein.

The object of our invention is to improve the sensitiveness of an oscillation detector of the aforesaid type.

Our invention may best be understood by having reference to the drawing which accompanies and forms a part of this specification and which represents in diagram one embodiment of our invention which has given good results in practice.

In the drawing, the figure represents a space telegraph receiving system.

The audion shown in the drawing consists of a vessel D of glass or other suitable material which may be evacuated and in which are included a heated member F, which may be a filament, an electrode H, herein shown as a plate which may be of platinum, and a conducting member G, which may be a grid or screen and which may be interposed between said filament and electrode. The filament F may be heated preferably to incandescence by the battery A or other suitable source of electrical energy. A local circuit connecting the filament F and electrode H includes a telephone T or other suitable signal-indicating device and a source of electromotive force B, the positive terminal of which is connected to the electrode H. The filament F and conducting member G are connected to a closed oscillation circuit, herein shown as the oscillation circuit C I_1, and, as shown, they are connected across the terminals of the condenser C.

V I_1 E is an elevated conductor system including the primary of the transformer M and the circuit C I_1, which includes the secondary of said transformer is made resonant to the frequency of the waves the energy of which is to be received.

We have found that the sensitiveness of the audion, when connected as above described with a closed oscillating circuit is greatly impaired from causes which are somewhat obscure and which we deem it unnecessary to discuss herein. The probable cause is that the conducting member G becomes negatively charged.

We have found that the sensitiveness of the audion may be greatly increased when connected as above described by inserting in the connections of the filament F and conducting member G to the oscillating circuit a source of electromotive force Z having its positive terminal connected to said conducting member and having an electromotive force determined by adjustment with respect to that of the source B which is included in the above mentioned local circuit.

While for the purpose of more clearly disclosing our invention we have described particularly one specific embodiment thereof, it will be understood that many modifications may be made therein without departing from the principle of our invention.

We claim,

1. A space telegraph receiving system having in combination a vessel, a heated member included therein, an electrode included in said vessel, a local circuit connecting said heated member and electrode, a source of electromotive force included in said local circuit and having its positive terminal connected to said electrode, a conducting member included in said vessel, connections from said heated member and conducting member to a closed oscillation circuit, and a source of electromotive force included in said connections and having its positive terminal connected to said conducting member.

2. A space telegraph receiving system having in combination a vessel, a heated member included therein, an electrode included in said vessel, a local circuit connecting said heated member and electrode, a source of electromotive force included in said local circuit and having its positive terminal connected to said electrode, a conducting member sealed within said vessel, connections

from said heated member and conducting member to a closed oscillation circuit, and a source of electromotive force included in said connections and having its positive terminal connected to said conducting member, the electromotive force of the last mentioned source being adjusted with respect to that of the source included in said local circuit.

In testimony whereof, we have hereunto subscribed our names this 1st day of Jan. 1907.

JOHN STONE STONE.
SEWALL CABOT.

Witnesses:
E. B. TOMLINSON,
GEO. K. WOODWORTH.

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PAGE

1435

L. DE FOREST.

SYSTEM FOR AMPLIFYING FEEBLE ELECTRIC CURRENTS.

APPLICATION FILED JUNE 30, 1907.

995,126. Patented June 13, 1911.

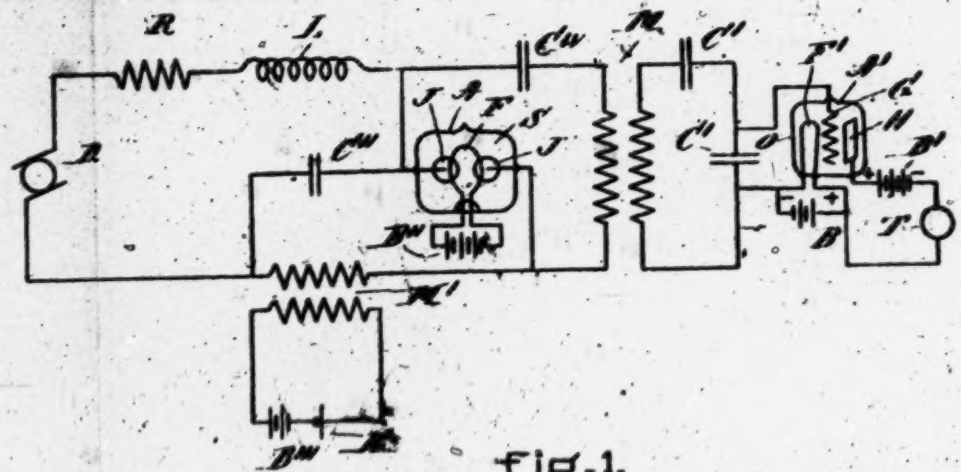


Fig. 1.

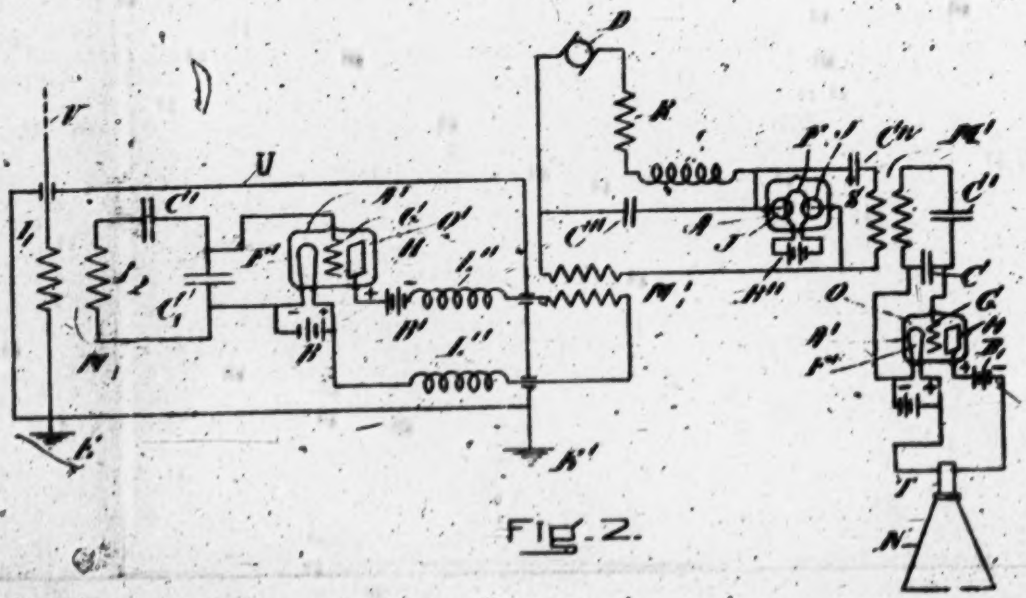


Fig. 2.

WITNESSES:
Patrick J. Bowmey
George H. Hoppe

INVENTOR
Lee de Forest
by Wm. Wadsworth

UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR TO DE FOREST RADIO TELEPHONE CO., A CORPORATION OF NEW YORK.

SYSTEM FOR AMPLIFYING FEEBLE ELECTRIC CURRENTS.

995,126. Specification of Letters Patent. Patented June 13, 1911.

Application filed June 20, 1907. Serial No. 379,294.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Systems for Amplifying Feeble Electric Currents, of which the following is a specification.

The present invention relates to systems for amplifying feeble electric currents and its object is to provide such system capable of use in wire telephone or telegraph lines and in space telegraph or space telephone systems.

My invention consists essentially in the interposition between the currents to be amplified and the signal indicating device of a source of high frequency electrical oscillations, hereinafter more fully described, and between said source of electrical oscillations and said signal indicating device I may interpose a circuit including an oscillation responsive device.

The drawings which accompany and form a part of this specification illustrate conventionally several arrangements of apparatus and circuits whereby the above mentioned object has been realized in practice; but it will be understood that I do not limit myself to the precise arrangements shown inasmuch as many modifications may be made therein without departing from the principle of my invention.

In the drawings: Figure 1 represents one form of my invention applied to a wire telephone system. Fig. 2 is a diagram representing the present invention applied to a space telegraph or telephone receiving system.

In the figures, D is a source of direct current, R is a resistance, inductive or non-inductive, L represents an inductance which may be employed, C, C' C'' C^{iv} C^{v} are condensers, M M' M_1 M_2 are transformers, B B' B'' B''' are batteries, K is a microphone transmitter, N is a megaphone, and T is a signal-indicating device which may be a telephone receiver.

In Fig. 1, the circuit S C^{iv} M and in Fig. 2 the circuit S C^{iv} M^1, represents a source of high frequency electrical oscillations having a spark frequency higher than the more essential frequencies accompanying speech waves and preferably higher than the limit of audibility. In the present instance said circuit is shown as a "singing-arc" circuit capable of developing practically continuous electrical oscillations when it is connected with the source of direct current D through leads of high resistance or high inductance.

In Figs. 1 and 2 I have represented the discharger for the condenser C^{v} as consisting of two electrodes J J sealed in a receptacle A and maintained in any suitable atmosphere under small or large pressure. The filament F may be heated by the current of the battery B^{ii}. It will be understood however that I do not limit myself to any special type of discharger and that any suitable source of high frequency oscillations having the characteristics above set forth may be substituted for the circuit S C^{iv} M^1, or S C^{iv} M.

O represents an oscillation detector of any suitable type and herein shown as an audion consisting of the evacuated vessel A' having sealed therein the filament F' heated by the battery B, the grid G and the plate H, the latter being connected to the positive pole of the battery B' and with the signal indicating device T. The audion O is associated in any suitable manner with the tuned circuit M C^{i} C^{i}, which in turn is associated with the source of high frequency oscillations. In the present instance said tuned circuit is shown as inductively related to the circuit S C^{iv} M by means of the oscillation transformer M, although any other associating means may be employed.

In Fig. 2 V represents a receiving antenna connected to earth E through the primary I_1 of the oscillation transformer M, whose secondary I_2 forms part of the tuned receiving circuit which includes the condensers C^{i}, C_1. Associated with said tuned receiving circuit in any suitable manner is the audion or other suitable oscillation detector O', the local circuit of which includes the primary of the transformer M', and if desired, the choke-coils L'' L''.

The telephone circuit and the local circuit of the audion O' are shown in Figs. 1 and 2 respectively as associated with the high frequency oscillation circuit by means of the transformers M' M'_1, although it will be understood that any other suitable means may be employed to associate the circuit which carries the currents to be amplified

more that I do not limit myself to the association of the said circuits with said oscillation circuit at the particular point shown in Figs. 1 and 2, viz., a point in the leads to said oscillation circuit. When the circuits are arranged in the manner shown in Figs. 1 and 2, the condenser C'' may be employed to afford a path of low impedance for the currents developed in the transformers M', M'$_1$. Preferably, the inductive relation of the tuned circuits M C' C'' with the oscillation circuit should be maintained by a transformer of small magnetic leakage, if a transformer is employed.

In Fig. 2, U represents a metallic case which may be grounded at E E'.

The operation is as follows: The feeble electrical currents developed in the primary of the transformer M' or M'$_1$ are impressed upon the high frequency oscillation circuit, thereby varying the amplitude of the oscillations in said circuit in accordance with the sounds initiating said feeble currents. The energy of said oscillations, so varied in amplitude, is transmitted to the circuit M C' C', attuned to the frequency of said oscillations, and actuates the oscillation responsive device O causing thereby currents in the circuit of the telephone T closely approximating in form those developed in the primary of the transformer M' or M'$_1$, but greatly exceeding the latter in amplitude. It has been found that the tuned receiving circuit M C' C' need not be employed and also that the oscillation detector O may be omitted as shown in Fig. 3. In this case the telephone receiver T responds to variations in the amplitude of the currents developed in the line Q Q, the frequency of said currents exceeding that to which the diaphragm of said telephone responds.

I claim:

1. The combination with a circuit carrying feeble electric currents of a source of practically-continuous electrical oscillations associated with said circuit, and including arc electrodes, with capacity and inductance in series shunt thereto, an oscillation responsive device, a circuit attuned to the frequency of said electrical oscillations interposed between said source and said oscillation responsive device, and a local circuit including therein a signal indicating device and a source of electro-motive force, associated with said oscillation responsive device.

2. The combination with a circuit carrying feeble electric currents of a source of practically-continuous electrical oscillations associated with said circuit and including arc electrodes with capacity and inductance in series shunt thereto, an oscillation responsive device, a circuit attuned to the frequency of said electrical oscillations interposed between said source and said oscillation responsive device, a local circuit including therein a signal indicating device associated with said oscillation responsive device, and a source of electromotive force in circuit with said signal indicating device.

3. The combination with a circuit carrying feeble electric currents of a source of practically-continuous electrical oscillations associated with said circuit, said source comprising a singing-arc circuit provided with inclosed arc-electrodes, an audion associated with said singing-arc circuit, and a local circuit including a telephone receiver and a source of electromotive force associated with said audion.

4. The combination with a circuit carrying feeble electric currents of a source of high frequency electrical oscillations having a frequency higher than the more essential frequencies accompanying speech waves, an oscillation responsive device associated with said source of electrical oscillations and a signal-indicating device associated with said oscillation responsive device.

In testimony whereof, I have hereunto subscribed my name this 17th day of June 1907.

LEE DE FOREST.

Witnesses:
THOMAS I. GALLAGHER,
ROSCOE KENT.

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PAGE

1438

G. SEIBT.

RADIO-TELEPHONY.

APPLICATION FILED DEC. 30, 1907.

1,012,456. Patented Dec. 19, 1911.

Fig. 1.

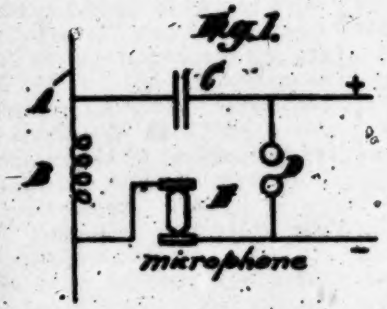


Fig. 2.

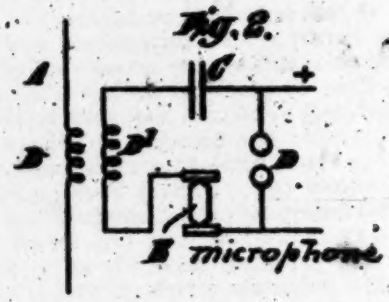


Fig. 3.

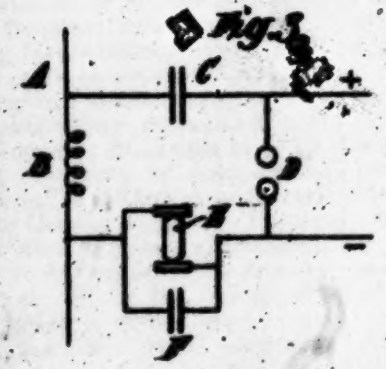


Fig. 4.

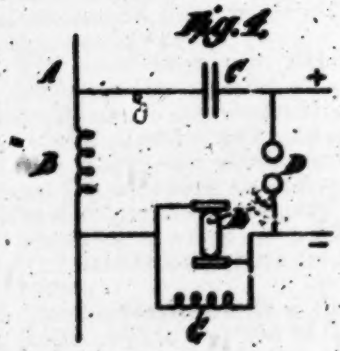
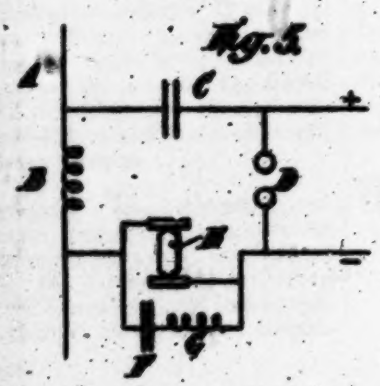


Fig. 5.



Witnesses:
A. L. Hutchin.
[illegible] Simon

Inventor
Georg Seibt
by Munn & [illegible]
his Attys

UNITED STATES PATENT OFFICE.

GEORG SEIBT, OF BERLIN, GERMANY, ASSIGNOR TO THE AMALGAMATED RADIO-TELEGRAPH COMPANY, LIMITED, OF LONDON, ENGLAND.

RADIO-TELEPHONY.

1,012,456. Specification of Letters Patent. Patented Dec. 19, 1911.

Application filed December 20, 1907. Serial No. 407,207.

To all whom it may concern:

Be it known that I, GEORG SEIBT, a subject of the Emperor of Germany, residing at 18 Mathiesstrasse, Berlin, in the Empire of Germany, have invented certain new and useful Improvements Relating to Radio-Telephony, of which the following is a specification.

This invention relates to radio-telephony, the chief object being to increase the efficiency of working of radio-telephonic systems.

It is well known that radio-telephony can be produced by means of electrical oscillations by subjecting the intensity of the oscillations produced by the human voice at the transmitting station to rythmical changes. For this purpose some device is required which will cause either the resistance, the inductance, or the capacity, or any combination of these factors, to vary in accordance with the variations of air pressure which constitute acoustic vibrations. That is to say, the alternate compression and rarefaction of the air must be made to produce corresponding changes in either the amplitude, or the periodicity, of the electrical radiations. The simplest form for such an arrangement is to insert a variable resistance, such as a microphone, directly into the antenna or into a circuit coupled with the antenna. By doing so there arises however the disadvantage—if microphones with any kind of resistance are chosen—that only a very small efficiency can be obtained by changing the vibrations of the air into variations of electrical intensity.

According to the present invention the variable resistance is brought into such relation to the fixed resistances that the variation of pressure produced by the acoustic vibrations causes a maximum variation of radiated electrical energy. In the case in which the oscillations are produced in the antenna itself or transferred to it by loose coupling from a closed oscillation-circuit, and assuming the microphone to be inserted directly into the oscillation circuit, theory shows that the resistance of the microphone ought to be numerically equal to the other resistances of the antenna, or in other words, that the damping produced by the microantenna itself. This is shown by the following consideration of an antenna excited by a loosely coupled closed oscillation circuit:—Let e represent the E. M. F. induced in the antenna, J the strength of the current, w_m the resistance of the microphone, and w the effective alternating current resistance of the antenna. Then, while having resonance, the strength of current is given by the following equation:—

$$J = \frac{e}{w + w_m}.$$

If the resistance of the microphone is, owing to sound waves falling upon the microphone block or plate, varied by an amount Δw_m, J will be increased or diminished by an amount ΔJ. The value of ΔJ is given by the equation:—

$$\Delta J = \frac{e}{w + w_m + \Delta w_m} - \frac{e}{w + w_m}$$

Therefore, assuming $(w + w_m + \Delta w_m)$ differs from $(w + w_m)$ by a negligible amount.

$$\Delta J = \frac{e \Delta w_m}{(w + w_m)^2}$$

If the resistance is only changed slightly as for instance by speaking, the value Δw_m will generally be proportional to the strength of the sound wave and will also be proportional to the resistance of the microphone itself. If the intensity of the sound is kept constant, the microphone having double the resistance of another one which is equivalent to the first in regard to its efficiency will suffer the double variation in resistance. Therefore it can be said that:—

$$\Delta w_m = K w_m$$

where K depends upon the intensity of the sound but not upon the resistance of the microphone. Substituting this value for Δw_m the equation becomes:—

$$\Delta J = \frac{e K w_m}{(w + w_m)^2}$$

It is important for radio-telephony that ΔJ becomes a maximum. Now ΔJ is a maximum or minimum when

By differentiating ΔJ with respect to w_m and equating to zero we obtain:—

$$\frac{d\Delta J}{dw_m} = \frac{eK(w+w_m)^2 - 2(w+w_m)(eKw_m)}{(w+w_m)^4} = \frac{eKw^2 - eKw_m^2}{(w+w_m)^4} = 0$$

Therefore $w=w_m$. Also

$$\frac{d^2\Delta J}{dw_m^2} = \frac{-2ekw_m(w+w_m)^4 - 4(w+w_m)^3(ekw^2 - ekw_m^2)}{(w+w_m)^8}$$

and this being a negative quantity shows that the condition $w=w_m$ makes ΔJ a maximum. Hence the condition for maximum efficiency is that the resistance of the microphone and of the system to which it is connected should be equal.

In the accompanying drawings, Figure 1 shows diagrammatically one method of carrying out my invention. Fig. 2 shows the antenna inductively coupled with an associated circuit. Fig. 3 shows the use of capacity in parallel with the variable resistance. Fig. 4 shows an inductance in parallel with such variable resistance. Fig. 5 shows capacity and inductance in series with each other and in parallel with the variable resistance.

A simple arrangement is shown in Fig. 1 of the accompanying drawings, in which A is the antenna, B an inductance, C a condenser, D the source of electrical oscillations, and E the microphone; the resistance of this microphone is equal to that of the system to which it is connected. Fig. 2 is similar to Fig. 1 with the exception that the antenna is inductively coupled to the oscillation circuit by means of the oscillation transformer B B'.

If the resistance of the microphone does not satisfy the above stated condition, its excess or lack of resistance may be compensated for; when the microphone has too high a resistance we may connect a condenser F or an inductance G of determined value in parallel with it as shown in Figs. 3 and 4 respectively; the effect of such a shunt circuit being to take part of the current and thus compensate for too high a resistance of the microphone alone. When the microphone has too low a resistance, a condenser and an inductance in series may be placed in parallel with it as shown in Fig. 5. The condenser and inductance in series connected across the microphone constitute an oscillatory circuit, which if adjusted out of tune with the received oscillations would tend to damp them, and in this way compensate for too low a resistance of the microphone alone. The same may be done when the microphone, instead of being inserted into the antenna, is inserted into a closed circuit loosely coupled with the antenna as it is in Fig. 2. In the case of a shunt circuit being employed with the microphone, the damping due to the microphone and shunt circuit in combination should be equal to the damping due to the resistance of the rest of the system comprising the antenna. When the antenna is coupled rigidly to the oscillation-circuit there will be different relations between the proportion of the resistance of the microphone and the other resistances of the oscillation circuits on account of the circuits affecting each other mutually. But it is always desirable, even if the maximum were not very sharp, to keep the amount of energy consumed by the microphone equal or nearly equal to the energy spent in the system to which it is connected.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a system of radio-telephony in which the transmitting apparatus comprises means for producing and transmitting electrical oscillations, and means comprising an ohmic resistance which coöperates with the first mentioned means and is capable of causing variations in intensity of the electrical oscillations by amounts corresponding to the variations of acoustic vibration produced by speaking; means for relatively adjusting the aforesaid ohmic resistance and the resistance of the system with which it coöperates until they are approximately equal.

2. In a system of radio-telephony in which the transmitting apparatus comprises means for producing and transmitting electrical oscillations, and means comprising electrical resistance coöperating with the first mentioned means for varying the electrical oscillations by amounts corresponding to variations of acoustic vibrations produced by speaking, means contained in a circuit shunted from the said electrical resistance for making the damping effect of the latter and of the shunt circuit in combination equal to that due to the resistance of the system to which they are connected.

In testimony whereof I affix my signature in presence of two witnesses.

GEORG SEIBT.

Witnesses:
WOLDEMAR HAUPT,
ARTHUR SCHROEDER.

1441

R. VON LIEBEN & E. REISZ.
RELAY FOR UNDULATORY CURRENTS.
APPLICATION FILED JAN. 20, 1911.

1,038,910.

Patented Sept. 17, 1912.

2 SHEETS—SHEET 1.

Fig. 1

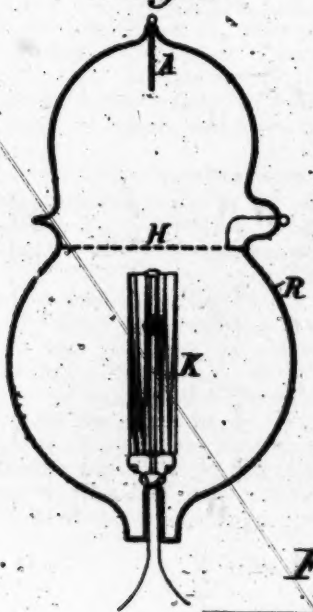


Fig. 2

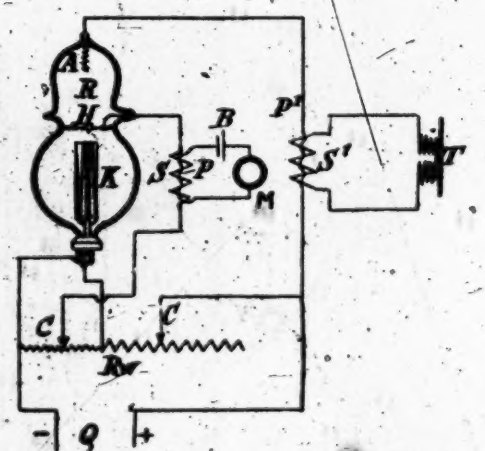
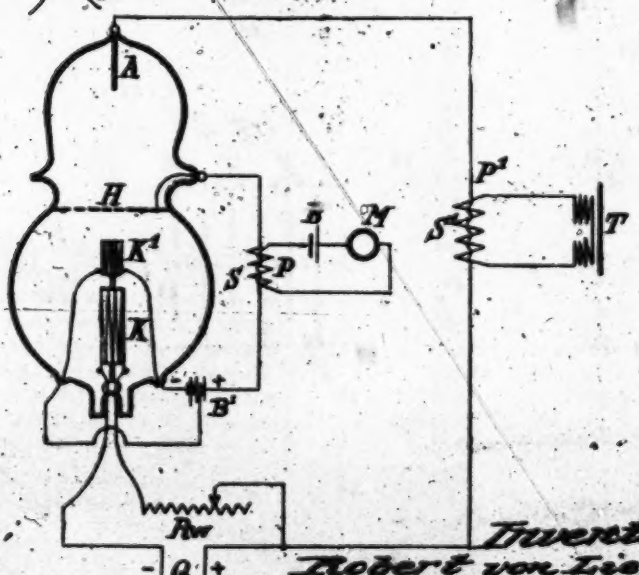


Fig. 2a



Witnesses:

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Eugen Reisz
by

1442

R. VON LIEBEN & E. REISZ.

RELAY FOR UNDULATORY CURRENTS.

APPLICATION FILED JAN. 30, 1911.

1,038,910.

Patented Sept. 17, 1912.

2 SHEETS—SHEET 2.

Fig. 3

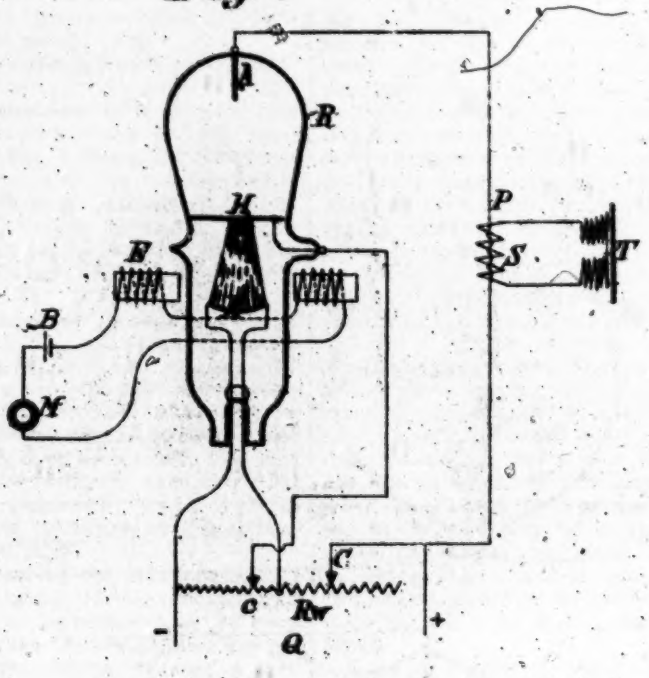
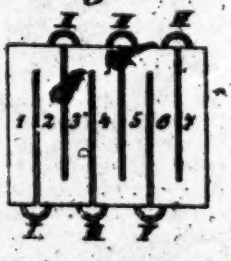


Fig. 3a



Witnesses:

Inventors
Robert von Lieben
Eugen Reisz

by

Simon L. Morris
Atty

UNITED STATES PATENT OFFICE.

ROBERT von LIEBEN AND EUGEN REISS, OF VIENNA, AUSTRIA-HUNGARY, ASSIGNORS OF ONE-THIRD TO SIEGMUND STRAUSS, OF VIENNA, AUSTRIA-HUNGARY.

RELAY FOR UNDULATORY CURRENTS.

1,038,910. Specification of Letters Patent. Patented Sept. 17, 1912.

Application filed January 29, 1911. Serial No. 605,548.

REISSUED

To all whom it may concern:

Be it known that we, ROBERT von LIEBEN and EUGEN REISS, subjects of the Emperor of Austria-Hungary, residing at Vienna, Austria-Hungary, have invented certain new and useful Improvements in Relays for Undulatory Currents, of which the following is a specification.

This invention relates to improvements in undulatory current relays, and the primary object of the same is to reinforce current waves of the most varied frequency and form.

The invention as hereinafter disclosed and illustrated in the drawings constitutes an improvement on that disclosed in our co-pending application Serial No. 605,547, wherein by means of varying the ionization of the space between the electrodes, as for instance by means of cathode rays, the resistance of the circuit connected to the electrodes is altered so that the current waves introduced will produce proportionate variations.

The subject of the present invention is a further development of the above mentioned invention, wherein instead of being altered indirectly by means of an ionizer the resistance in the main circuit is altered directly by means of an auxiliary electrode, on which the currents to be reinforced act. For this purpose the auxiliary electrode, which is likewise made of grid or net form, is arranged in such a manner that it completely intersects or divides the space between the cathode and anode in the discharge tube; moreover, it is connected with a source of direct current in such a manner that it has an exactly defined potential corresponding to the degree of reinforcement required for the time being. In order to enable this potential to be adjusted as required, an adjustable resistance is preferably introduced between the electrode and the source of electric current. By this means the valve-like action of the incandescent electrode is dispensed with, since the alternating current to be reinforced is superposed on a constant direct current, whereby an undulatory current is formed from the alternating current. Also the presence of the constant potential of the electrode, the magnitude of which is suitably chosen between that of the cathode and that of the anode, causes the formation of an artificial dark space near the cathode and thus of a space where the number of ions is small, around the apertures of the auxiliary electrode toward the anode, whereby again the resistance of the main circuit, which is just what it is desired to alter, is considerably increased. This displacement of the maximum drop of potential into proximity to and into the openings of the auxiliary electrode and also the circumstance that this grid-electrode entirely fills up the cross-section of the discharge tube, permit the employment of currents which are practically of any desired strength, since here the formation of an arc outside the grid is rendered impossible and the formation of an arc in the apertures of the grid is rendered very difficult by the production of the artificial dark space near said apertures.

The openings or contractions, as is known, form a virtual resistance for the gas discharge, which resistance, however, as we have discovered, can be very considerably altered if, between the cathode and the partition-wall, a constant but regulable voltage be applied; and it appears that even with a very slight increase or reduction of the potential-difference, the resistance or back electromotive force in the discharge tube will be smaller or greater. The currents to be reinforced now alter the resistance of the auxiliary electrode, whereby the currents passing between the cathode and anode are altered in proportion to this resistance.

The drawings show by way of example some constructional forms of the subject of the application.

In these drawings: Figure 1 is a section of the discharge tube. Fig. 2 is a diagram of the connections of the relay. Fig. 2ª shows a further constructional form of the relay with an auxiliary cathode. Fig. 3 shows a further constructional form of the subject of the application, wherein another method of altering the resistance of the auxiliary electrode is employed. Fig. 3ª is a development of the cathode belonging thereto.

In Fig. 1 the cathode K is arranged in the discharge tube R. This cathode is preferably an incandescent metallic oxid cathode (a Wehnelt cathode) and has the form of incandescent metal bands covered with metallic oxids, which bands are wound on a carrier or support in a similar manner

to that in which metal filament lamps are constructed. This construction of the cathode has the advantage that the irregularly distributed cathode rays emitted by the incandescent bands (filaments) do not strike the auxiliary electrode directly whereby the current density is uniformly distributed over the auxiliary electrode. H is the said auxiliary electrode, which divides or intersects the space between the cathode K and the anode A and is preferably made in the form of wire gauze or netting or perforated sheet metal or as a combination of the two.

The cathode K, in combination with a regulating resistance Rw (Fig. 2) which regulates the temperature of the incandescent metal bands, is connected to the source of direct current Q. The anode A is connected to the positive pole of the said source of current through the primary winding P'. To the regulating resistance Rw is further connected at c the auxiliary electrode H through the secondary winding of a second transformer. As shown in Fig. 2, the microphone circuit BM acts inductively on the gas current between K and H through the primary winding P. The voltage which exists between the cathode K and the auxiliary electrode H, is given by the adjustment of the contact c of the regulating resistance Rw. This application of a regulable pressure has been found to be an extremely important expedient for the sensitiveness of the relay, since a proportionally strong alteration of resistance in the gas discharge tube only occurs with a quite definite value of the voltage and this depends on the pressure of the gas in the tube, the temperature of the electrode, etc. It was further established by experiment that with greater strengths of the current and more especially with such strengths as first render the relay practically useful, the auxiliary electrode H, as above mentioned, must entirely shut off the cross-section of the tube, since otherwise shunting of the gas-current would occur, which almost entirely destroys the action of the relay.

The method of operation of the relay is as follows: The currents from the microphone circuit superposed inductively on the circuit between K and H through the transformer PS alter the back electromotive force or resistance of the gas discharge tube, so that the main current passing through the anode A acts through the second transformer T S' on the telephone T. As already set forth, with a definite difference of potentials between K and H, which can be adjusted by means of the sliding contact c, the resistance of the gas discharge produced by the auxiliary electrode is extremely sensitive and the small variations of potential caused by the variations of resistance of the microphone are therefore sufficient to alter the strength of the current in the discharge tube very considerably, so that a powerful relay action is obtained.

In Fig. 2 a second cathode K' is provided, which is connected to a separate source of current B', and to the positive pole of which the electrode H is connected through the transformer. Since in this system of connections the temperature of the cathode K' can be made independent of the cathode K, the drop of potential at the cathode K' can be very considerably reduced by correspondingly high temperature of the bands at K' and consequently the variations of current of the transformer PS increased, without the main current flowing to the anode in the discharge tube being considerably increased. The temperature of the main cathode and therefore the current flowing through the anode A cannot be increased indefinitely, since at a critical value of the current determined by the cross-section of the tube the sensitiveness of the relay again decreases.

Another form of construction of the relay is shown in Fig. 3. In this, the cathode K is made in the form of a concave mirror, in order to unite the rays emitted thereby into one pencil; H is the auxiliary electrode, which is again arranged as a partition-wall between the cathode and anode and has an opening or window, provided with a perforated metal sheet or wire gauze forming a grid. The anode A is connected in a known manner to the positive pole of Q. The pair of electromagnets E is connected in series with the microphone M and a battery. In the opening or window of the auxiliary electrode H is mounted a piece of perforated sheet metal, a grid or a combination of the two, in order to increase the back electromotive force or rather the main resistance to be altered of the tube between K and A. The regulating resistance Rw with the contacts c and C is connected as in the form shown in Fig. 2. The alterations of current in the microphone circuit cause the pencil of rays to be deflected, whereby the apertures in the window of the auxiliary electrode H, to which a constant direct current potential can be applied, are more or less struck by the pencil of cathode rays and are therefore subjected to an ionization of varying intensity. By this means the back electromotive force or the resistance in the main circuit between K and A is altered according to the variations of current in the primary. The back electromotive force or resistance in the discharge tube increases when the pencil of rays is deflected from the opening and decreases when the pencil of rays strikes the opening or window. The concave mirror cathode is preferably made in such a manner that in order to avoid too high currents for the

heating thereof, the conductor is arranged in zigzag form and the several strips are mechanically supported relatively to each other by fire-proof bridge-pieces *e. g.*, of glass or porcelain, as shown by way of example in Fig. 3ª, in which the transverse members of the zigzag conductor produced by slotting a sheet of platinum alternately on opposite sides are marked 1, 2, 3, and the glass bridge-pieces I, II, III.

For both arrangements experiments have shown that for the proportional reproduction of alternating currents, the openings in the partition-wall must be made of different sizes.

The above described relay for undulating currents can be employed for strengthening sound, as a relay in overhead wire and cable telephony in short and long distance communication, also in wireless telegraphy and telephony, as an auxiliary apparatus for the telegraphone and as a cell sensitive to light for the electric transmission of pictures, etc.

What is claimed is:

1. A relay for undulatory currents comprising a discharge tube, a cathode and an anode therein, an auxiliary electrode to cause a drop of potential between the cathode and anode and formed with apertures and intersecting the space in the discharge tube between said cathode and anode and dividing it into separate parts, and a source of direct current connected to said auxiliary electrode.

2. A relay for undulatory currents comprising a discharge tube, a cathode and an anode therein embodied in an electric circuit with said cathode, an auxiliary electrode formed with apertures and intersecting the space between the cathode and the anode, a source of direct current connected to said auxiliary electrode, the latter forming a resistance for the currents in the circuit, and means for varying said resistance in accordance with the currents to be reinforced.

3. In a relay for undulatory currents, an exhausted discharge tube, a cathode and an anode therein, embodied in an electric circuit, a grid-like auxiliary electrode intersecting the discharge tube between the cathode and the anode and dividing it into separate parts, a source of direct current connected to the auxiliary electrode, the latter forming a resistance for the currents in the circuit, an adjustable resistance between said source of direct current and the auxiliary electrode, and means for varying the resistance of said electrode in accordance with the currents to be reinforced.

4. In a relay for undulatory currents, an exhausted discharge tube, a cathode of metallic oxid filaments heated to incandescence, the filaments being wound on a carrier in the manner of a metal filament lamp, an anode embodied in an electric circuit with said cathode, a grid-like auxiliary electrode intersecting the space of the discharge tube and dividing it into separate parts, this electrode being perpendicular to the axis of the carrier, a source of direct current connected to said electrode, the latter thus forming a resistance for the currents in the circuit, an adjustable resistance between the source of direct current and the electrode, and means for varying the resistance of said electrode in accordance with the currents to be reinforced.

5. In a relay for undulatory currents, an exhausted discharge tube, a cathode and an anode therein embodied in an electric circuit, a grid-like auxiliary electrode intersecting the discharge tube between the cathode and the anode and dividing it into separate parts, a source of direct current connected to the auxiliary electrode, an adjustable resistance in the circuit between the source of direct current and the auxiliary electrode, and means to superpose the undulating currents to be reinforced on said circuit.

6. In a relay for undulatory currents, an exhausted discharge tube, a cathode and an anode therein embodied in an electric circuit, an auxiliary cathode embodied in a separate circuit, a grid-like auxiliary electrode intersecting the discharge tube between the auxiliary cathode and the anode and dividing it into separate parts, a source of direct current connected to the auxiliary electrode and the circuit of the auxiliary cathode, and means to superpose the undulating currents to be reinforced on the circuit of the direct current source.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

ROBERT VON LIEBEN.
EUGEN REISZ.

Witnesses:
JOSEF RUDERSDORF,
AUGUST FUGGER.

1446

H. DE P. ARNOLD.
ELECTRIC RELAY.
APPLICATION FILED MAY 16, 1914.

1,114,845. Patented Oct. 27, 1914.

Fig. 1.

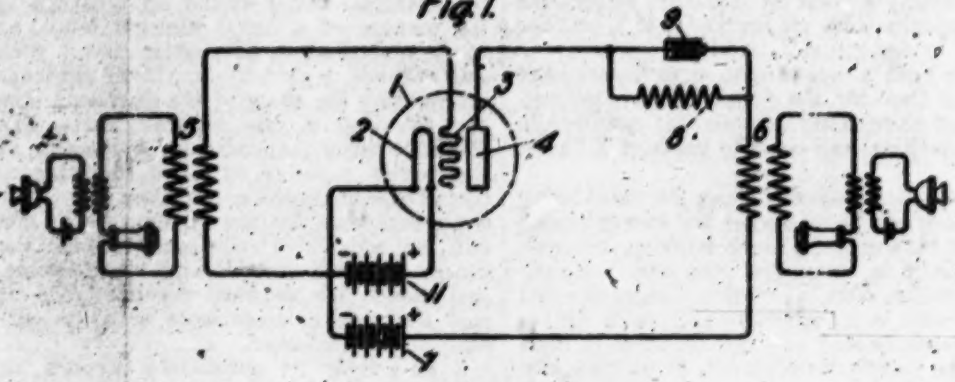


Fig. 2.

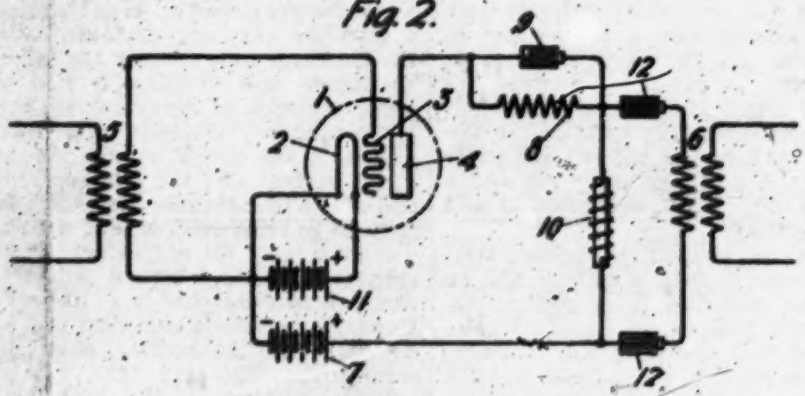
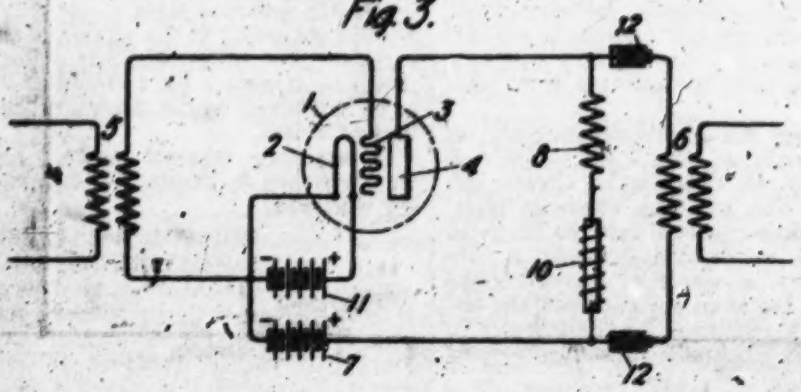


Fig. 3.



Witnesses:
C. C. M. Luther
John Waldheim

Inventor:
Harold D. Arnold.
by L. C. Stuart Atty

UNITED STATES PATENT OFFICE.

HAROLD DE FOREST ARNOLD, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

ELECTRIC RELAY.

1,114,845. Specification of Letters Patent. Patented Oct. 27, 1914.

Application filed May 16, 1914. Serial No. 839,066.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Electric Relays, of which the following is a full, clear, concise, and exact description.

This invention relates to devices for amplifying feeble impulses of electrical energy, and more particularly to the audion as a repeater.

It has been found in the usual audion structure that when energies of considerable magnitude, such, for instance, as are encountered in ordinary telephone systems, are impressed upon the input circuit of the audion, a blue haze appears in the bulb of the audion. This blue haze may be produced in the bulb either by raising the potential of the battery in the output circuit of the audion to an excessive value, or it may be produced by an increase in potential beyond a certain value between the grid and the filament. When the blue haze is present, the audion becomes inert and ceases to function as an amplifier. For instance, when used as a telephone relay, the transmission ceases almost entirely when the blue haze appears. It has been found experimentally that the establishment of the condition of discharge described above as the blue haze may be prevented by placing, in series with the battery, a balancing resistance of such high value that the increase in current which would normally take place when the condition in the bulb corresponding to the blue haze exists, results in such an increase in fall of potential across the resistance as to render the maintenance of the condition corresponding to blue haze impossible.

In the accompanying drawing,—Figure 1 is a diagram illustrating one embodiment of the invention; and Figs. 2 and 3 are diagrams illustrating slight modifications of the system.

Like reference characters refer to like parts throughout the several views.

In said figures, the evacuated vessel 1 is provided as usual with a heated filament 2, a grid 3 and a plate 4. This device is well known in the art and is termed an audion. The input circuit of the audion includes the secondary coil of a transformer 5, the grid 3 and the filament 2. The output circuit of the audion includes the plate 4, the primary coil of a transformer 6, the filament 2 and the battery 7. In accordance with this invention, there is included in this output circuit a balancing resistance 8. In Fig. 1, the resistance 8 is shown as connected in series with the primary winding of the transformer 6, a condenser 9 being placed in shunt of said resistance in order to permit the passage of fluctuating current.

In Fig. 2 an impedance coil 10 is placed in a bridge of the output circuit, the condensers 12, 12 being provided to prevent the passage of direct current from the battery 7 while at the same time permitting the passage of fluctuating current.

In Fig. 3 the balancing resistance 8 is placed in series with the impedance 10 in a bridge of the output circuit.

The input circuit of the audion is inductively connected with the incoming line by the transformer 5, and the output circuit of the audion is inductively connected with the outgoing line by the transformer 6. The filament 2 is connected to the opposite poles of a battery 11 in order to maintain said filament in a state of incandescence.

What is claimed is:

In an electric relay, the combination with an audion having an input and an output circuit, said output circuit including a source of direct current, of a balancing resistance in the output circuit in series with said source of direct current and a condenser in shunt of said resistance, said balancing resistance being of such high value that the increase of current which normally takes place when a blue haze exists in the bulb of the audion, results in such an increase in fall of potential across said resistance as to prevent the maintenance of said blue haze.

In witness whereof, I hereunto subscribe my name this 14 day of May, A. D., 1914.

HAROLD DE FOREST ARNOLD.

Witnesses:
KATHERINE L. STAHL.
ELLA EDLER.

1448

G. W. PIERCE,

APPARATUS FOR AMPLIFYING OR DETECTING ELECTRICAL VARIATIONS.

APPLICATION FILED MAR. 11, 1914.

1,127,371. Patented Feb. 2, 1915.

Fig. 1.

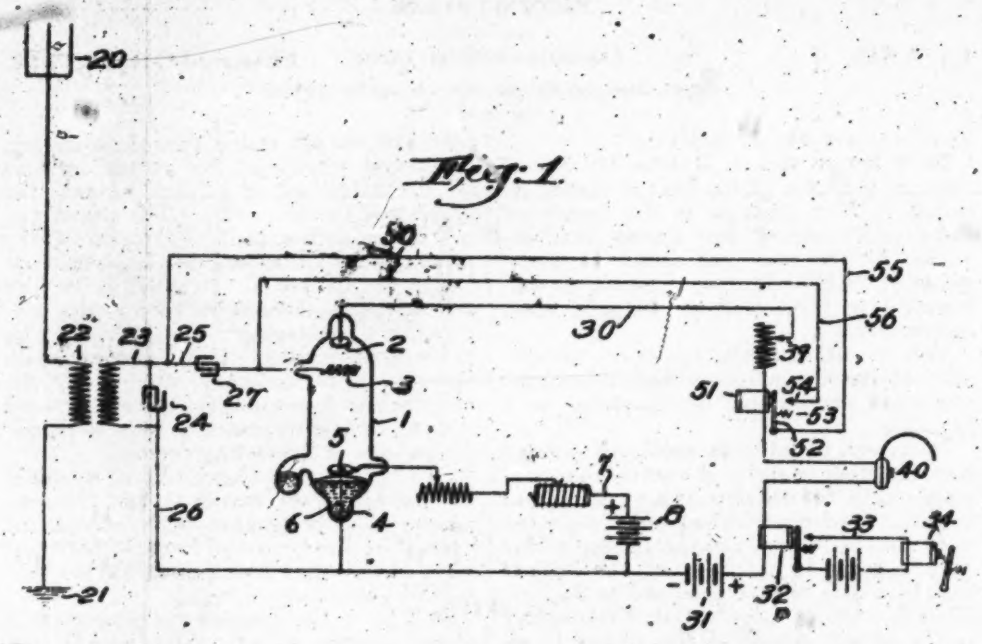
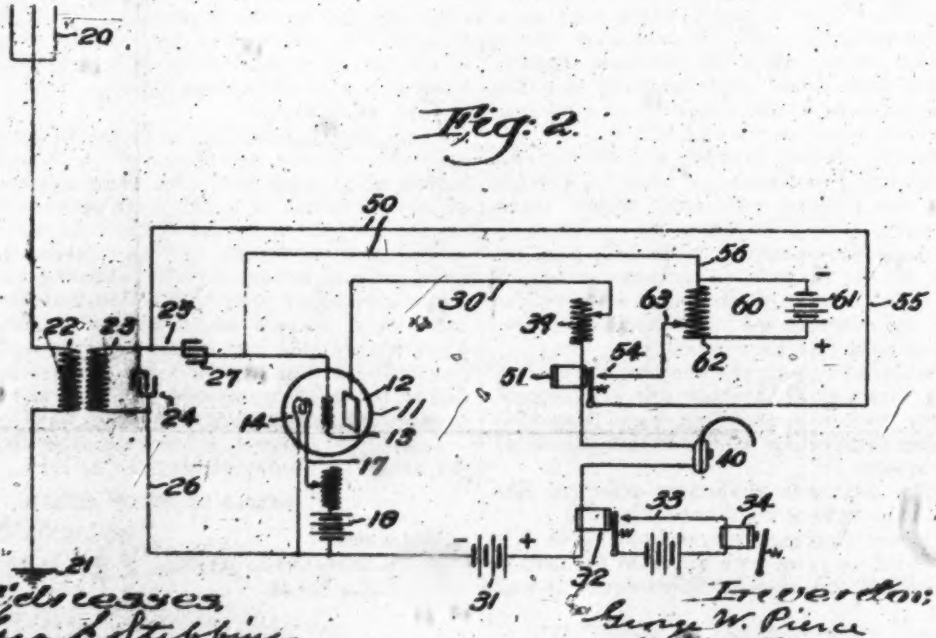


Fig. 2.



Witnesses:
Geo. L. Stubbins.
Alice Ackroyd

Inventor:
George W. Pierce
by his attorneys
Phillips, Van Orsdel & Kirk

UNITED STATES PATENT OFFICE.

GEORGE W. PIERCE, OF CAMBRIDGE, MASSACHUSETTS.

APPARATUS FOR AMPLIFYING OR DETECTING ELECTRICAL VARIATIONS.

1,127,371. Specification of Letters Patent. Patented Feb. 2, 1915.

Application filed March 11, 1914. Serial No. 824,692.

To all whom it may concern:

Be it known that I, GEORGE W. PIERCE, a citizen of the United States, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Amplifying or Detecting Electrical Variations; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to an apparatus for amplifying or detecting electrical variations.

In the apparatus illustrated and described in my Patent No. 1,112,655, October 6, 1914, apparatus for receiving or relaying electric signals, and my Patent No. 1,112,549, October 6, 1914, apparatus for amplifying or detecting electrical variations, a body of gas in an evacuated tube is maintained in a sensitive conducting condition by means of an ionizing agency, such as a hot filament or a mercury arc. Associated with the ionizing agency are two electrodes. One electrode serves as an anode and is connected through a controlled circuit to the ionizing agency. The second electrode is an open-work electrode or screen and is interposed between the first electrode and the ionizing agency. The screen is connected by means of a controlling circuit to some point in the controlled circuit, either at the ionizing agency or at the anode. In the controlling circuit is a condenser which serves to insulate the screen from the controlled circuit. When electrical oscillations are impressed upon the controlling circuit, they pass through the condenser and cause oscillations of potential on the screen. There is apparently a rectifying action at the screen so that during the train of oscillations the screen acquires a negative charge. As pointed out in Patent No. 1,112,549, the apparatus is ordinarily adjusted to the intensity of the received impulses so that after the cessation of the train of received oscillations the screen loses its negative charge very rapidly, and the evacuated tube quickly recovers its normal conductivity. It is found however that, when the apparatus is adjusted so that it will be sensitive to feeble received oscillations, if stronger oscillations are impressed on the controlling circuit there will be an appreciable time lag before the tube recovers its normal conductivity. This is believed to be due to an accumulation of a sufficiently great negative charge on the screen and condenser caused by the rectification of the impressed oscillations, so that the charge is not dissipated from the screen for an appreciable time.

The apparatus of the present invention is an improvement on the apparatus described in said applications and is so constructed that the evacuated tube quickly recovers its normal conductivity after receiving a train of strong oscillations as well as after receiving a train of weaker oscillations. The present invention is however not limited to the type of detecting apparatus shown in said applications, but may be applied to other types of detecting apparatus in which there are accumulated electric charges which it is desirable to discharge.

In the drawings which illustrate the preferred embodiment of the invention, Figure 1 is a diagrammatic view showing the apparatus of the present invention applied to an evacuated vessel which is ionized by means of mercury arc; and Fig. 2 is a diagrammatic view showing the apparatus of the present invention applied to an evacuated vessel ionized by means of an incandescent filament.

In Fig. 1, the means for maintaining the sensitive conducting gaseous space comprises an evacuated vessel or tube 1 in which are inclosed an electrode 2, an open-work electrode or screen 3, and an ionizing agency which consists of a body of mercury 4 and a perforated arc terminal plate 5. A platinum wire 6 extends through and just projects from the mercury and serves as an arc centering device. The mercury arc is maintained by means of a magneto circuit 7 which includes battery 8. This mercury vapor tube is substantially the same as that shown in my Patent No. 1,112,549 and my Patent Number 1,087,180.

In Fig. 2, the means for maintaining a sensitive conducting gaseous space comprises an evacuated vessel or tube 11 in which are inclosed an electrode 12, an open-work electrode or screen 13, and an ionizing agency which consists of an incandescent filament 14. The incandescent filament is heated by means of a local circuit 17 which includes a battery 18. The evacuated ves-

al is substantially the same in arrangement of its parts as the filament ionized evacuated vessels shown in Patent No. 1,119,655.

In both Figs. 1 and 2, 20 indicates the antenna of a wireless receiving system connected to ground at 21. Instead of the antenna circuit illustrated in the drawings, other signal receiving circuits may be employed, such for example, as those indicated in my prior applications referred to above. The antenna circuit is coupled by means of an oscillation transformer 22 to a closed high frequency oscillation circuit 23 which contains a condenser 24. Tapped from the oscillation circuit 23 on the opposite sides of the condenser 24 are receptor leads 25 and 26. The leads 25 and 26 and their connections with the receiving apparatus constitute what may be termed the "controlling" circuit by means of which the electric potential variations set up in the receiving apparatus by the received waves are impressed upon the sensitive conducting gas in the tube. The receptor lead 25 is connected to the open-work electrode or screen. The receptor lead 26 is connected to one of the leading-in wires of the ionizing means, the connection in Fig. 1 being to the platinum wire 6, the connection in Fig. 2 being to one of the wires of the filament-heating circuit 17. This forms a connection from the controlling circuit to the controlled circuit, which is hereinafter described. A condenser 27 is interposed in the controlling circuit, preferably in the lead 25, and serves as a stoppage condenser to insulate the open-work electrode or screen from the controlled circuit. An electric circuit 30, which is designated as the "controlled" circuit is connected between the electrode 2 in Fig. 1 or the electrode 12 in Fig. 2, and the ionizing agency. In the circuit 30 is a battery 31, the positive pole of which is connected to the electrode 2. The electrode 2 and the ionizing agency serve as the anode and cathode electrodes respectively of the controlled circuit 30. The circuit 30 may be provided with a ballast resistance 32. Included in the circuit 30 is a relay 33. The relay 33 operates upon the decrease in current in the circuit 30 to close the sounder circuit 34 and operate the telegraphic sounder 35. When the train of Hertzian waves strikes the antenna, the apparent conductivity of the vapor tube is decreased and cuts down the current in the controlled circuit 30 causing the sounder 35 to operate. The construction and arrangement of the parts just described are substantially like that of Patent No. 1,119,849 and a further detailed description is not necessary. The telephone receiver 40 is also included in the controlled circuit 30 and may be used for audibly detecting received messages which are too faint to operate the relay and sounder. The telephone receiver may be used for detecting all received signals in which case the relay 33 and sounder circuit 34 may be dispensed with.

The device for permitting a rapid recovery of the conductivity of the vapor tube after the reception of a train of strong oscillations, comprises a shunt circuit 50 connected around the condenser 27 and a relay 51 which operates to close the shunt circuit upon a sufficient decrease in the current of the controlled circuit 30. The relay 51 is connected directly in the circuit 30 and operates while the normal current is flowing in the circuit 30 to attract and hold its armature 51. When the current in the circuit 30 drops below a predetermined amount, the relay armature 52 is released and is drawn by its spring 53 against the contact point 54. The armature 52 is connected by one of the lead wires 55 of the shunt circuit 50 to one side of the condenser 27, and the contact point 54 is connected through the other lead wire 56 to the other side of the condenser 27. The moving parts of the relay 51 are light so that they operate very rapidly.

The amount of decrease in current in the controlled circuit 30 is apparently dependent upon the strength of the received oscillations impressed on the open-work electrode or screen. When the received oscillations are comparatively feeble, the vapor tube recovers its normal conductivity rapidly after the cessation of the train of oscillations, and there is therefore no need of discharging any charges accumulating on the open-work electrode or screen. The relay 51 may be inoperative on very weak signals, so that the shunt circuit 50 is not closed upon the comparatively small decrease in current in the controlled circuit 30 incident to the reception of feeble oscillations. The telephone receiver 40 does respond however, to such current decrease. However, when the received oscillations are comparatively strong, there is a greater decrease in the current in the controlled circuit 30 as well as a tendency for the tube to have an appreciable time lag in recovering its conductivity. This tendency is corrected by the relay 51 which short-circuits the condenser 27. When there are impressed on the tube received impulses sufficiently strong to cause an objectionable time lag in the recovery of the tube, the current in the circuit 30 is reduced below a predetermined amount, and the relay 51 operates to close the shunt circuit 50. As soon as the shunt circuit 50 is closed the open-work electrode and the stoppage condenser are discharged and the tube immediately recovers its normal conductivity and the current in the circuit 30 momentarily rises and operates the relay 51 to open the shunt circuit 50, whereupon

the screen accumulates another charge and apparent conductivity of the tube again is lowered until the relay 51 again operates to short-circuit the condenser 27. During the reception of a train of strong oscillations, the relay 51 is continually vibrating. The integrated or average current in the controlled circuit 30 is however sufficiently reduced so that the relay 32 closes the sounder circuit 33. The relay 32 may be slow in operation so that the sounder 34 does not rattle during the reception of a train of strong impulses, but if desired, the relay 32 and sounder 34 may be quick acting and produce an interrupted motion by which the message may be read or recorded.

In Fig. 2, a source of electro-motive force 60 is included in the lead 56 of the shunt circuit 50. The source of electro-motive force 60 includes a battery 61, a resistance 62, with which a movable contact point 63 in the circuit 50 is connected. By adjusting the contact point 63, the electro-motive force impressed on the shunt circuit 50 may be varied. The action of this electro-motive force is to prevent the open-work electrode 13 from being entirely discharged when the condenser 27 is short-circuited through the shunt circuit 50, and consequently prevents the resistance of the tube 11 from being as greatly reduced as is the case when the condenser 27 is short-circuited through a shunt circuit like that in Fig. 1. In some cases it is desirable to use the source of electro-motive force 60 because a greater reduction in the current of the controlled circuit 30 may be had when the relay 51 is operating.

By means of the present invention the apparatus operates to receive strong as well as feeble oscillations. The apparatus is adjusted for the feeble oscillations and then the tendency which the strong impulses would otherwise have to delay the recovery of the tube is automatically prevented by means of the current controlled relay and shunt circuit. This is of particular importance in wireless telegraphy where it may be desirable to pick up successively a number of sending stations, the received oscillations of which vary in intensity.

The available sensitiveness of the receiving apparatus is increased because the apparatus may be adjusted to its maximum sensitiveness for the reception of feeble signal impulses and this adjustment need not be disturbed if the impulses grow stronger or other strong impulses are to be received.

It will be noted that the device for discharging the charges accumulated on the condenser and open-work electrode by the rectifying action of the tube does not operate continuously but is initiated by the received signal impulses and ceases to operate after the received signal impulses cease.

The present invention is not limited in its application to the particular forms and arrangement of the means for maintaining the gaseous conducting space or the connections of the controlling and controlled circuits, neither is the present invention limited to the particular apparatus for securing the quick recovery of the tube, but may be embodied in other constructions within the scope of the invention as pointed out in the following claims:—

I claim—

1. An apparatus for amplifying or detecting electrical variations having, in combination, means for maintaining a sensitive conducting gaseous space, a plurality of electrodes in the space, a controlled electric circuit including a source of electrical energy connected between two of the electrodes, a controlling electric circuit including a condenser connected to an electrode other than the controlled circuit electrodes, and means controlled by the current in the controlled circuit for shunting the condenser.

2. An apparatus for amplifying or detecting electrical variations having, in combination, an evacuated vessel, an electrode in the vessel, an ionizing agency in the vessel, a controlled electric circuit connected between the ionizing agency and the electrode, means for impressing an electromotive force on the controlled circuit, a second electrode in the vessel, a controlling electric circuit connected with the second electrode and including a condenser, and means controlled by the current in the controlled circuit for shunting the condenser.

3. An apparatus for amplifying or detecting electrical variations having, in combination, means for maintaining a sensitive conducting gaseous space, a plurality of electrodes in the space, a controlled electric circuit connected between two of the electrodes, means for from time to time temporarily varying the apparent conductivity of the space including a controlling circuit connected to an electrode other than the controlled circuit electrodes, and means controlled by the current in the controlled circuit for discharging charges accumulated on the controlling circuit electrode.

4. An apparatus for amplifying or detecting electrical variations, having, in combination, an evacuated vessel, an electrode in the vessel, an ionizing agency in the vessel, a controlled electric circuit connected between the ionizing agency and the electrode, means for impressing an electromotive force on the controlled circuit, means for varying the apparent conductivity of the space between the ionizing agency and the first electrode including a second electrode in the vessel and a controlling circuit connected between the second electrode and

the controlled circuit and including a condenser so as to insulate the second electrode from the controlled circuit, and means for automatically and quickly discharging electric charges accumulated on the second electrode.

5. An apparatus for amplifying or detecting electrical variations having, in combination, an evacuated vessel, an electrode in the vessel, an ionizing agency in the vessel, a controlled electric circuit connected between the ionizing agency and the electrode, means for impressing an electromotive force on the controlled circuit and acting normally to cause a current flow through the vessel between the ionizing agency and the electrode, means for from time to time temporarily decreasing the apparent conductivity of the space between the ionizing means and the electrode including a second electrode in the vessel and a controlled circuit including a condenser and connected to the second electrode, and means operating upon a decrease of the current in the controlled circuit below a predetermined amount for discharging electric charges accumulated on the second electrode.

6. An apparatus for amplifying or detecting electrical variations having, in combination, an evacuated vessel, an ionizing agency in the vessel, an electrode in the vessel, a controlled electric circuit connected between the ionizing agency and the electrode, means for impressing an electro-motive force on the controlled circuit and acting normally to cause a current flow through the vessel between the ionizing agency and the electrode, means for from time to time temporarily decreasing the apparent conductivity of the space between the ionizing agency and the electrode including a second electrode interposed between the ionizing agency and the first electrode and a controlling circuit connected between the second electrode and the controlled circuit, a condenser in the controlling circuit serving to insulate the second electrode from the controlled circuit, and current-operated means acting upon a decrease of the current in the controlled circuit below a predetermined amount to shunt the condenser.

7. An apparatus for amplifying or detecting electrical variations having, in combination, an evacuated vessel, an electrode in the vessel, an ionizing agency in the vessel, a controlled electric circuit connected between the ionizing agency and the electrode, means for impressing an electro-motive force on the controlled circuit, a second electrode in the vessel, a controlling electric circuit connected with the second electrode and including a condenser, and a relay for preventing the accumulation of too great an electric charge on the second electrode.

8. An apparatus for amplifying or detecting electrical variations having, in combination, means for maintaining a sensitive conducting gaseous space, a plurality of electrodes in the space, a controlled electric circuit connected between two of the electrodes, a controlling electric circuit connected to an electrode other than the controlled circuit electrodes and operating to cause the accumulation of an electrical charge on the controlling circuit electrode, and means external to the gaseous space for preventing the accumulation of too great an electric charge on the controlling circuit electrode.

9. An apparatus for amplifying or detecting electrical variations having, in combination, a high frequency circuit, a rectifying detector connected to said high frequency circuit through a stoppage condenser, a current source connected with the detector, and means operated by currents passed through the detector for discharging charges accumulated on the stoppage condenser.

10. An apparatus for amplifying or detecting electrical variations, having, in combination, a controlling circuit, a rectifying detector connected to said controlling circuit through a stoppage condenser, a current source connected with the detector, and means operated by currents passed through the detector for discharging charges accumulated on the stoppage condenser.

11. An apparatus for amplifying or detecting electrical variations having, in combination, a controlling circuit, a rectifying detector connected to said controlling circuit through a stoppage condenser, and means initiated by the received electrical variations for discharging charges accumulated on the stoppage condenser.

12. An apparatus for amplifying or detecting electrical variations having, in combination, a rectifying detector having a conductor which accumulates a rectified electric charge, and means initiated by the received electrical variations for discharging such accumulated charges.

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1453

H. DE F. ARNOLD.

GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE.

APPLICATION FILED MAY [illegible], 1914.

1,129,942.

Patented Mar. 2, 1915

2 SHEETS-SHEET 1.

Fig. 1.

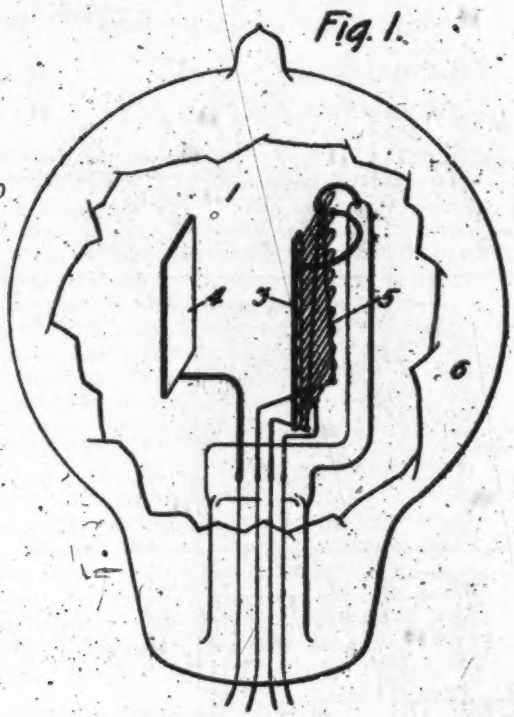
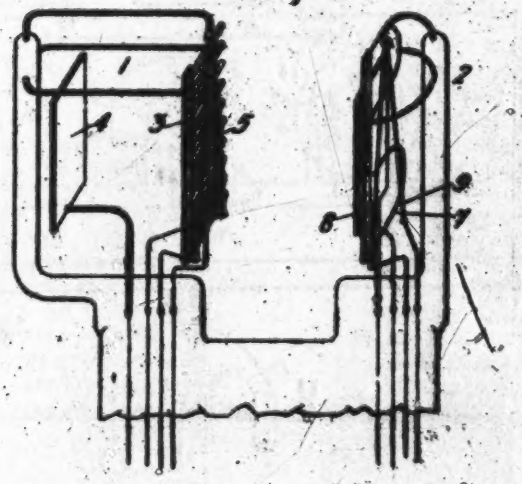


Fig. 2.



Fig. 3.



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1454

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GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE.

APPLICATION FILED MAY 26, 1914.

1,129,942.

Patented Mar. 2, 1915.

2 SHEETS—SHEET 1.

Fig. 4.

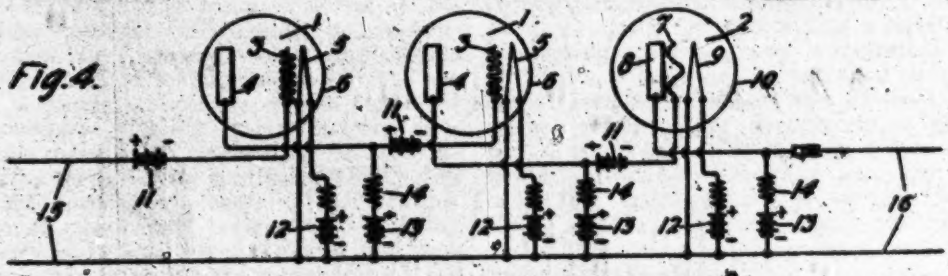


Fig. 5.



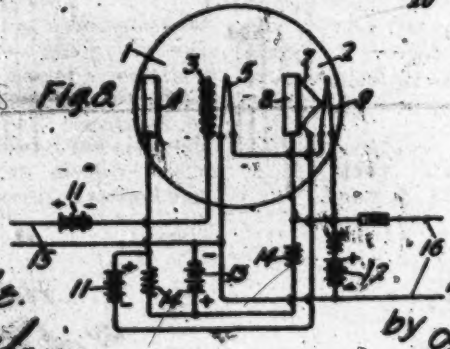
Fig. 6.



Fig. 7.



Fig. 8.



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UNITED STATES PATENT OFFICE.

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GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE.

1,129,942. Specification of Letters Patent. Patented Mar. 2, 1915.

Application filed May 23, 1914. Serial No. 841,562.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Gaseous Repeaters in Circuits of Low Impedance, of which the following is a full, clear, concise, and exact description.

This invention relates to the use of repeaters generally, and of vacuum discharge repeaters more particularly, as amplifiers without transformers.

Still more particularly, it relates to the use of thermionic repeaters for securing amplification of current in circuits of low impedance. By a thermionic current is meant current discharge from a hot cathode. Examples of thermionic repeaters are the De Forest audion disclosed in Patent No. 879,532, dated February 18, 1914, and others, the Von Leiben & Riesz repeater disclosed in Patent No. 1,038,910, dated September 17, 1912, etc. By vacuum discharge is meant current discharge between electrodes in space from which nearly all atmosphere is exhausted. The expression vacuum discharge repeaters is intended to include repeaters of the thermionic types and also those in which current flows between electrodes in space maintained in a conductive state by the arc or otherwise. The mercury arc repeater of an earlier application of this applicant, Serial No. 709,445, filed July 13, 1912, is an example of the class of vacuum discharge repeaters but it is not of the thermionic type.

In many instances it is necessary or desirable, for securing the best results, to exclude transformers from the circuit. Such is the case, for example in those circuits in which the frequency is so low that efficient transformers are costly and difficult to design, as is the case in telegraph circuits in general and especially in submarine and wireless telegraph circuits. It is particularly desirable to exclude transformers from circuits in which an exact reproduction of wave form is necessary for legibility, as, for example, in submarine cable circuits. It is also desirable to exclude transformers from circuits in which undistorted amplification must be secured over a wide range of frequencies, as, for example, in the reproduction of speech and music.

Heretofore it has been necessary to employ transformers in circuit with the audion in order to secure efficient amplification of current by the audion, and this is especially true where the amplification is desired in circuits of low impedance. This is due to the fact that the impedance of the input circuit of an efficiently operating audion is very high, at least 100,000 ohms and in general as high as 10 megohms. Hence, in a circuit of low impedance, if no transformer is used, the larger part of the possible current amplification by the audion is lost. For example, if the impedance of the input circuit of the audion is only 100,000 ohms and the input circuit of the audion be connected, without the use of transformers, in a line of 1000 ohms impedance, at least 99% of the possible current amplification is lost. Moreover, in the case of audions of the prior art, the impedance in the output circuit of the audion is always so great that a considerable additional loss of possible amplification must occur if the output circuit of the audion is directly connected to a circuit of low impedance.

It has been discovered that audions of the usual type may be so constructed that, without the use of transformers, they will step up the input voltage of either direct current or alternating current of any frequency in one step to as much as 20 times its original value, or in two successive steps to as much as 500 times its original value. The voltage amplification thus secured is entirely free from wave distortion whatever may be the initial frequency and wave form. This type of audion will, for convenience, be hereinafter referred to as the high-voltage output audion.

It has furthermore been discovered that audions may be constructed which will step down the input voltage, for example, to one-

third of its original value. This last mentioned type of audion has a high current and a low voltage output. Because of its low output impedance, such type of audion can be worked efficiently into a line of like impedance. This new type of audion will, for convenience, hereinafter be referred to as the high-current output audion.

The structures which will provide the greatest degree of efficiency in the above mentioned different types of audions form the subject-matter of a copending application in my name, Ser. No. 831,567 filed of even date herewith.

It has been discovered that a combination of one or more of the aforementioned high-voltage output type of audions working into one of the high-current output type, will operate, without transformers, from a line of low impedance, for example, 250 ohms, into a like line with a resultant current much greater, fifty or more times greater, than would flow in the second circuit if it were directly connected to the first circuit. The present invention is directed to such combination of two different types of repeaters, preferably audions. A system designed to secure the same result and employing a large number of the high-voltage output type of audions connected in multiple and working into a common output circuit in lieu of a single audion of the high-current output type, forms the subject-matter of still another application for patent in my name, Ser. No. 841,569 filed of even date herewith.

The present invention may be more readily understood by reference to the accompanying drawings in which—

Figure 1 is a view in perspective of an audion of the high-voltage output type; Fig. 2 is a similar fragmentary view of an audion of the high-current output type; Fig. 3 is a similar fragmentary view of the two different types of audions embodied in a unitary structure; Fig. 4 shows a circuit arrangement embodying this invention in which a plurality of audions of the high-voltage type in tandem, work into an audion of the low-voltage type; Fig. 5 shows a simplified circuit arrangement giving the same result as in Fig. 4; Fig. 6 shows a still further [illegible] particularly applicable to telephone circuits; Fig. 7 shows a plurality of audions of the high-voltage type in tandem working into a plurality of audions of the high-current output type, each of the latter feeding into a separate output line; and Fig. 8 shows a circuit arrangement embodying the invention in which the two different types of audions are combined in one bulb.

The reference characters [illegible] the several figures.

In the drawings, the audions 1 are of the high-voltage output type and the audions 2 are of the high-current output type. In the former type, the input electrode may be in the form of a grid, preferably made of very fine wire with a fine mesh or the like, and the output anode or plate 4 is placed at a considerable distance from the cathode which is preferably a filament 5, as shown. The filament need not present a large active area. The filament, grid and plate are as usual sealed in an evacuated bulb 6. In order to secure best results in this type of audion, the grid should be near the filament, the plate should be distant from the filament, and the grid should present a finely meshed or discontinuous surface between the filament and the plate.

In the high-current output type of audion, the input electrode or grid 7 may be at any side of the filament and should have a coarse mesh or preferably consist merely of a short length of wire. The output electrode or plate 8 is placed as near to the filament 9 as is conveniently possible. The filament preferably presents a large, active area. The filament, grid and plate are as usual sealed in an evacuated bulb 10. In order to secure the best results in this type of audion, the grid and plate should both be near the filament, the filament area should be large, and the grid should present the least possible obstruction between the filament and plate.

As hereinbefore stated, the high-voltage output type of audion gives an amplification with low current and high voltage in its output circuit; whereas the high-current output type gives amplification with high current and low voltage, and hence low impedance, in its output circuit.

In Fig. 4, two high-voltage output audions 1, 1 connected in tandem are shown working into a high-current output audion 2. The batteries 11 are preferably of such value as to make each of the grids 3, 3 and 7 normally about five volts negative with respect to its adjacent filament. The several filaments are heated by the respective batteries 12. The output circuit of each audion includes its plate, a high resistance 14, a battery 13 and the filament of the audion. The resistance 14 should be, for example, 100,000 ohms or more. The input circuit of the first audion of the group is directly connected to the input line 15. The input voltage on the grid of the first audion 1 causes an increase in the voltage of the current flowing in the output circuit of said audion, thereby developing a voltage change on the grid of the next audion of the series, and so on. As a result of such construction and arrangement of these audions, the voltage in the input circuit of the second of the two

audions in tandem is much greater than that impressed upon the first, although the current in the interconnecting circuit is small. The audion 2 acts as an amplifier in which the current is increased and the voltage lowered in its output circuit. Because of the fact that the impedance in the output circuit of the audion 2 is lowered, it can be worked efficiently into a line 16 of low impedance. It has been found, for example, that the amplifying means shown in Fig. 4 will work from an incoming line of 250 ohms impedance into an outgoing line of like impedance with a resultant current of more than fifty times that which would flow in the outgoing line if the latter were directly connected to the incoming line.

Fig. 5 shows a simplification of the system illustrated in Fig. 4, in that a common battery 12 furnishes current to all the filaments, said filaments being connected in series with the battery, and a common battery 13 serves for all of the plates.

Fig. 6 shows a further simplification of the system illustrated in Fig. 5. An impedance coil 17 is included in bridge of the output circuit of each audion, and in the output circuit of the two audions 1, 1, condensers 18, 18 are inserted in series with the resistances 14. By such arrangement the several batteries 11 may be largely reduced in voltage. This arrangement is particularly applicable to embodiment in a telephone system.

Fig. 7 shows a plurality of the high-voltage output audions in tandem working into a plurality of the high-current output audions, each of the latter working into its own output circuit 19, 20 or 21. Otherwise, the circuit arrangement is substantially that shown in Fig. 5. The arrangement shown in Fig. 7 is particularly applicable to the operation of several loud-speaking receivers from a common talking circuit.

Fig. 8 shows a structure and circuit arrangement in which an audion of the high-voltage output type works into an audion of the high-current output type, the two audions being contained in a single bulb and operating from a common filament having one branch 5 for the audion 1 and another branch 9 for the audion 2. The input electrode 7 of the audion 2 is shown in the form of a short length of wire. The circuit arrangement is substantially that illustrated in Figs. 4 and 5, and further description thereof is deemed unnecessary. This structure and arrangement have been found to operate successfully, without the interposition of transformers, between lines of the impedance of ordinary telephone lines.

As applied to submarine cable work for amplifying the feeble current at the receiving end the invention is of special importance. The large amplification attained makes it possible to operate over such cables at greatly increased speed. Furthermore, less delicate recording devices will suffice as a substitute for the ordinary siphon recorder. Moreover, the high amplification secured renders possible the direct repetition from one section of a cable to another or from submarine to land telegraph lines. The invention is also particularly adapted for use in circuits where especially pure, loud reproduction of speech or music is desired. In general in the art of submarine, land and wireless telegraphy, the invention is of importance with reference to recording, high-speed working and direct repetition from one type of system to another type of system.

What is claimed is:

1. The combination with a source of feeble electric currents, of a thermionic repeater having an input circuit directly connected to said source of current and an output circuit of high voltage, and a second thermionic repeater having an output circuit of low impedance and having an input circuit directly connected to the output circuit of said first mentioned repeater.

2. The combination with a plurality of thermionic repeaters connected in tandem, the first repeater of the series having a high-voltage output and the last repeater of the series having a high-current output.

3. The combination with an incoming and an outgoing line of low impedance, of a plurality of thermionic repeaters in tandem, the first of said repeaters having a high-voltage output and the last of said repeaters having a high-current output, and the first of said repeaters having its input circuit directly connected to said incoming line, and the last of said repeaters having its output circuit directly connected to said outgoing line.

4. The combination with a line of low impedance, of a current amplifying means directly connected therewith, said amplifying means comprising a plurality of thermionic repeaters in tandem, the first of said repeaters having a high-voltage output and the last of said repeaters having a high-current output.

5. The combination with a repeater, of a plurality of vacuum discharge repeaters connected in multiple with the output circuit of said first mentioned repeater, said mentioned repeater having a high-voltage output and said other repeaters each having a high-current output.

6. The combination with a thermionic repeater, of a plurality of thermionic repeaters connected in multiple into which said first mentioned repeater works, said first mentioned repeater having a high-voltage

output and said other repeaters having a high-current output.

7. The combination of two thermionic repeater structures connected in tandem and having a common inclosing bulb, the first of said structures having a high-voltage output and the other a high-current output.

In witness whereof, I hereunto subscribe my name this 25 day of May, A. D. 1914.

HAROLD DE FOREST ARNOLD.

Witnesses:
E. EDLER,
K. L. STAHL.

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PAGE

1459

H. DE F. ARNOLD.

GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE.

APPLICATION FILED MAY 28, 1914.

1,129,943. Patented Mar. 2, 1915.

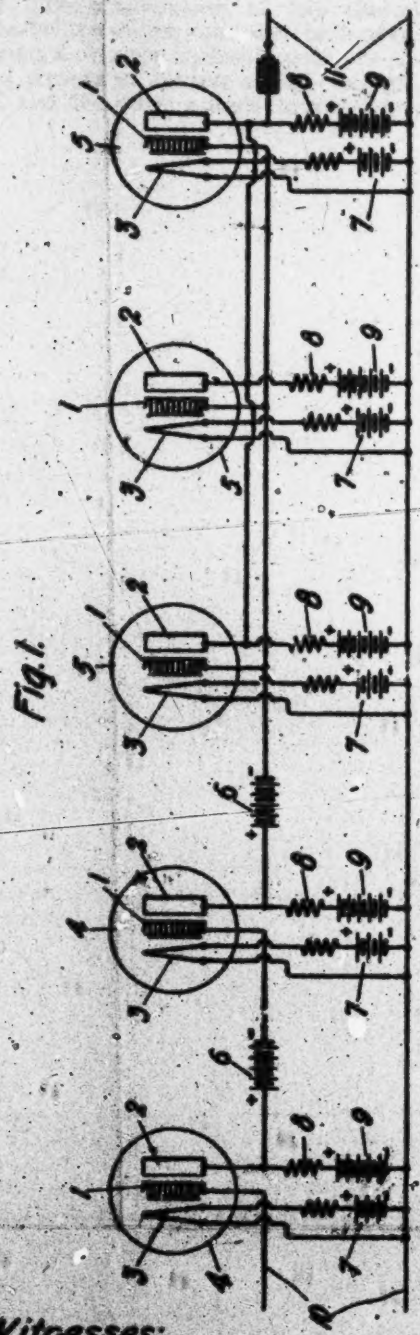


Fig. 1.

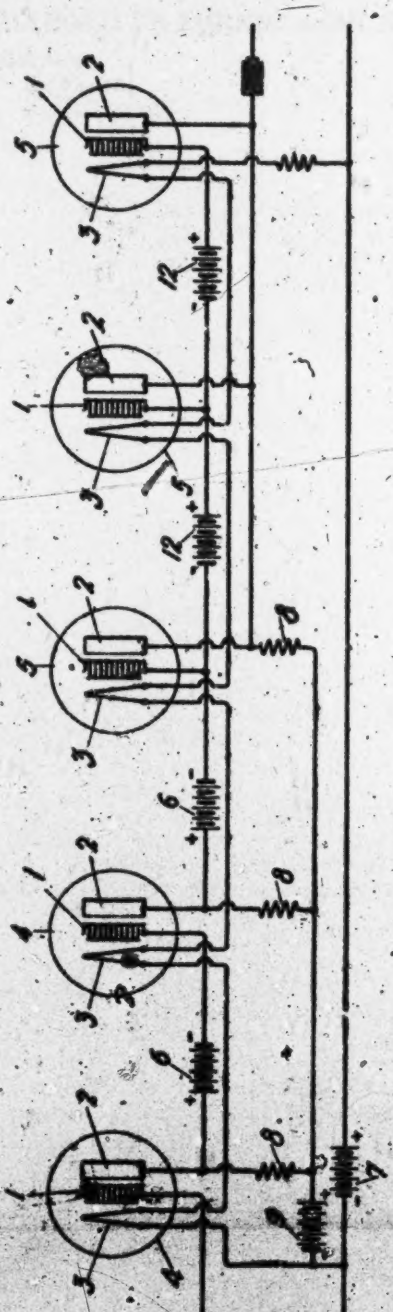


Fig. 2.

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UNITED STATES PATENT OFFICE.

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GASEOUS REPEATER IN CIRCUITS OF LOW IMPEDANCE.

1,129,943. Specification of Letters Patent. Patented Mar. 2, 1915.

Application filed May 28, 1914. Serial No. 841,569.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Gaseous Repeaters in Circuits of Low Impedance, of which the following is a full, clear, concise, and exact description.

This invention relates to the use of thermionic repeaters, such as the audion, as amplifiers without transformers, and more particularly to the use of thermionic repeaters for securing amplification of current in circuits of low impedance.

In many instances it is necessary or desirable, for securing the best results, to exclude transformers from the circuit. Such is the case, for example, in those circuits in which the frequency is so low that efficient transformers are costly and difficult to design, as is the case in telegraph circuits in general and especially in submarine and wireless telegraph circuits. It is particularly desirable to exclude transformers from circuits in which an exact reproduction of wave form is necessary for legibility, as, for example, in submarine cable circuits. It is also desirable to exclude transformers from circuits in which undistorted amplification must be secured over a wide range of frequencies, as, for example, in the reproduction of speech and music.

Heretofore it has been necessary to employ transformers in circuit with the audion in order to secure efficient amplification of current by the audion, and this is especially true where the amplification is desired in circuits of low impedance. This is due to the fact that the impedance of the input circuit of an efficiently operating audion of the usual type is very high, at least 100,000 ohms and in general as high as 10 megohms. Hence, in a circuit of low impedance if no transformer is used, the larger part of the possible current amplification by the audion is lost. For example, if the impedance of the input circuit of the audion is only 100,000 ohms and the input circuit of the audion is connected, without the use of transformers, in a line of 1000 ohms impedance, at least 99% of the possible current amplification is lost. Moreover, in the case of audions of the prior art, the impedance in the output circuit of the audion is always so great that a considerable additional loss of possible amplification must occur if the output circuit of the audion is connected without the use of a transformer in a circuit of low impedance.

It has been discovered that audions may be so constructed that without the use of transformers they will step up the input voltage of either direct current or alternating current of any frequency in one step to as much as thirty times its original value, all in two successive steps to as much as 500 times its original value. The voltage amplification thus secured is entirely free from wave distortion whatever may be the initial frequency and wave form. It has been discovered that the output voltage of one of such audions or of a plurality thereof in tandem may be stepped down and the resultant current greatly amplified by having such audion or plurality of audions work into a plurality of similar audions in multiple, with the output of each going to a common circuit. This common output will be an amplified current of relatively low voltage. It has been discovered that a combination of one or more of such audions working into a sufficiently large number, for example from fifty to one hundred, of similar audions in multiple, with a common output, will operate, without transformers, from a line of low impedance, for example 250 ohms, into a like line with a resultant current much greater, fifty or more times as great, than would flow in the second circuit if it were directly connected to the first circuit. The present invention is directed to such combination of audions. A system designed to secure the same result and employing a single audion of a special type, in lieu of such audions in multiple, forms the subject-matter of another application for patent in my name, Ser. No. 841,568 filed of even date herewith.

The present invention may be more readily understood by reference to the accompanying drawings in which—

Figure 1 shows a circuit arrangement embodying this invention in which a plu-

rality of audions in tandem work into a plurality of similar audions in multiple, the output going to a common circuit; and Fig. 2 shows a simplified circuit arrangement giving the same result as in Fig. 1.

Like reference characters refer to like parts in both of said figures of the drawings.

The several audions may be of the usual construction, but to secure most efficient results the input electrode may be in the form of a grid 1, preferably made of very fine wire with a fine mesh or the like, and the output electrode or plate 2 is placed at a considerable distance from the filament 3. The filament, grid and plate are as usual sealed in an evacuated bulb. In order to secure best results, the grid should be near the filament, the plate should be distant from the filament, and the grid should present a finely meshed or discontinuous surface between the filament and the plate. This type of audion is adapted to give an amplification with low current and high voltage in its output circuit.

In Fig. 1, two audions 4, 4 in tandem are shown working into three audions 5, 5, 5 in parallel. The number of audions 4 in tandem employed will depend upon the amount of amplification desired. In case more than one audion 4 is used, they are, as shown, connected in tandem. Likewise the number of audions 5 in parallel will depend upon the characteristics required in their common output circuit, an increasing number of such multipled audions 5 giving a decreasing voltage and increasing current. The batteries 6 are preferably of such value as to make each of the input electrodes or grids 1 normally about five volts negative with respect to its adjacent filament 3. The several filaments are heated by the respective batteries 7. The output circuit of each audion includes its output electrode or plate 2, a high resistance 8, a battery 9 and the filament of the audion. The resistance 8 should be, for example, 100,000 ohms or more. The input circuit of the first audion of the group is directly connected to the input line 10. The input voltage on the grid of the first audion 4 causes an increase in the voltage of the current flowing in the output circuit of said audion, thereby developing a voltage change on the grid of the next audion 4 in series. As a result of such construction and arrangement of these audions, the voltage in the input circuit of the second of the two audions in tandem is much greater than that impressed upon the first, although the current in the interconnecting circuit is small. The audions 5 work into a common output line 11 and being connected in parallel act to step down the voltage and correspondingly increase the current. This presents to the common output line 11 an impedance inversely proportional to the number of the multipled audions. Hence for the most successful operation into a line of low impedance, for example, 30 ohms, a large number of audions in parallel would be required to provide in their common output line 11 an impedance approximately equal to the impedance of the line to which direct connection is to be made. By combining two or more audions in tandem working into a number of audions in multiple, for example, from ten to one hundred, the combined system will operate, without the use of transformers, from an incoming line of low impedance into an outgoing line of like impedance with a resultant current of more than fifty times that which would flow in the outgoing line if the latter were directly connected to the incoming line.

Fig. 2 shows a simplification of the system illustrated in Fig. 1, in that a common battery 7 furnishes current to all the filaments, said filaments being connected in series with the battery. The batteries 12, 12 are introduced to compensate for the voltage drop through the filaments. A common battery 9 serves for all of the output electrodes 2.

As applied to submarine cable work for amplifying the feeble current at the receiving end, the invention is of special importance. The large amplification attained makes it possible to operate over such cables at greatly increased speed. Furthermore, less delicate recording devices will suffice as a substitute for the ordinary siphon recorder. Moreover, the high amplification secured renders possible the direct repetition from one section of a cable to another or from submarine to land telegraph lines. The invention is also particularly adapted for use in circuits where especially pure or loud reproduction of speech or music is desired. In general in the art of submarine, land and wireless telegraphy, the invention is of importance with reference to recording, high-speed working and direct repetition from one type of system to another type of system.

What is claimed is:

1. The combination of a plurality of thermionic repeaters in multiple having a common output line, and a thermionic repeater working into said multipled repeaters.

2. The combination of a set of thermionic repeaters in multiple having a common output line, and a set of thermionic repeaters in tandem working into said first mentioned set of repeaters.

3. The combination with a line of low impedance, of an audion having its input circuit directly connected to said line, and a plurality of audions in multiple into which said first mentioned audion works, said multipled audions having a common output line.

4. The combination with an incoming and an outgoing line of low impedance, of a set of audions in tandem directly connected to said incoming line, and a set of audions in multiple into which said first mentioned set works, said last mentioned set being directly connected to said output line.

In witness whereof, I hereunto subscribe my name this 25 day of May A. D., 1914.

HAROLD DE FOREST ARNOLD.

Witnesses:
E. EDLER,
K. L. STAHL.

1463

E. H. COLPITTS.

SYSTEM FOR AMPLIFYING ELECTRIC WAVES.

APPLICATION FILED APR. 8, 1914.

1,129,959. Patented Mar. 2, 1915.

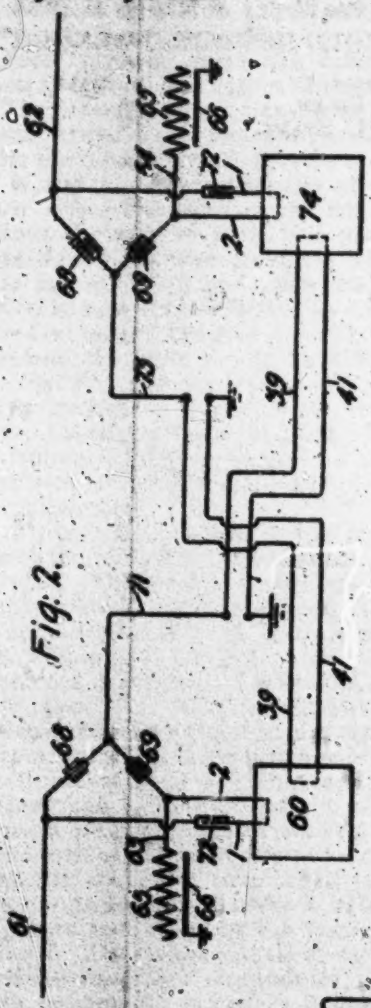


Fig. 2.

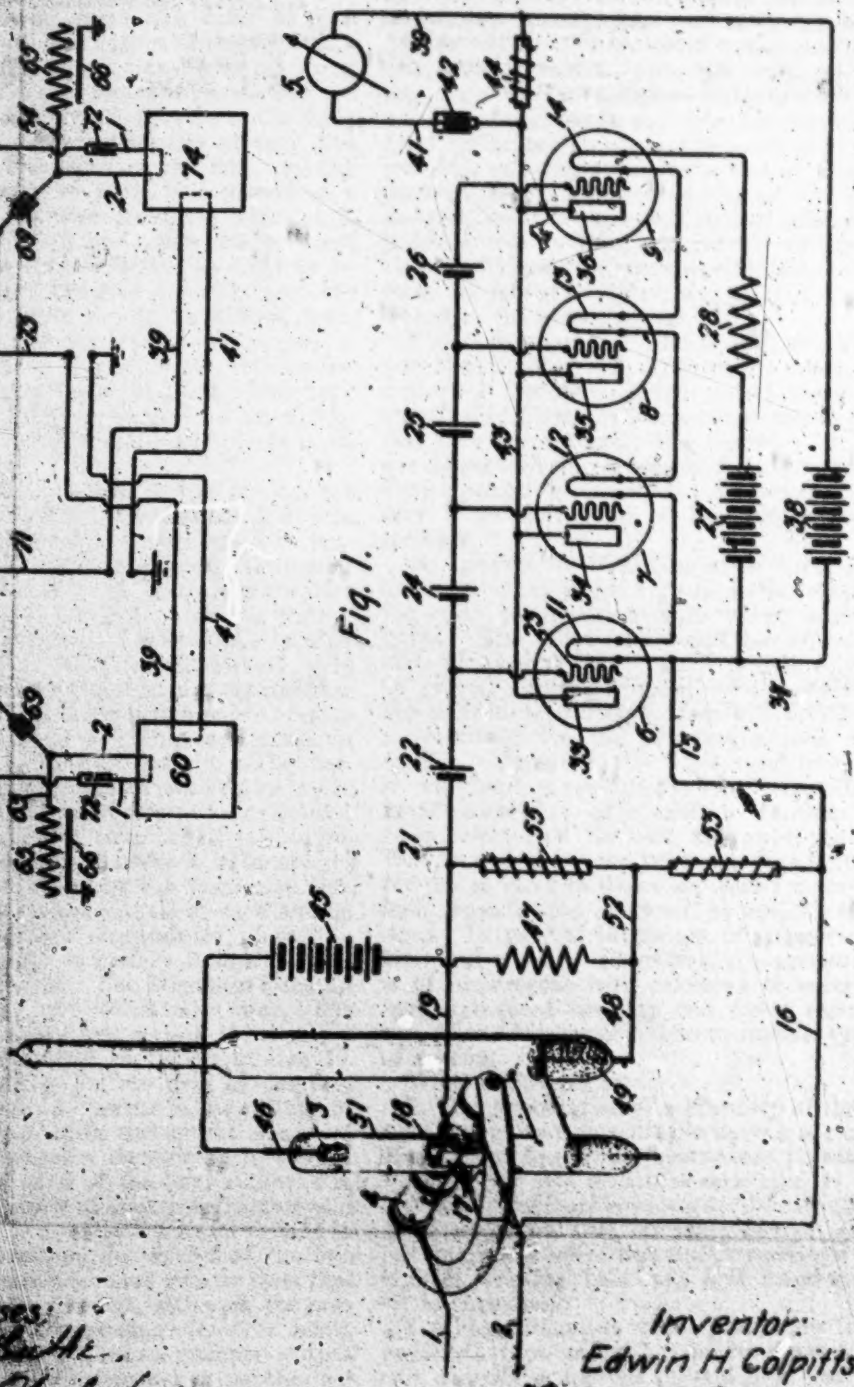


Fig. 1.

Witnesses:
[illegible]
John Wahlheim

Inventor:
Edwin H. Colpitts.
By John G. Roberts
Atty.

UNITED STATES PATENT OFFICE.

EDWIN H. COLPITTS, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

SYSTEM FOR AMPLIFYING ELECTRIC WAVES.

1,129,959. Specification of Letters Patent. Patented Mar. 2, 1915.

Application filed April 4, 1914. Serial No. 829,207.

To all whom it may concern:

Be it known that I, EDWIN H. COLPITTS, a subject of the King of Great Britain, residing at East Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Systems for Amplifying Electric Waves, of which the following is a full, clear, concise, and exact description.

This invention relates to electric signaling, and particularly to signaling over ocean cables.

One of its objects is to amplify efficiently very feeble low frequency electric waves.

A special object is to provide an efficient amplifying system adapted without transformers for use at the receiving end of a signaling circuit.

A well known law of electric circuits requires that the impedance of the external path in the circuit should be equal to the impedance of the internal path or source, whenever the maximum of available energy is desired. In ocean cable telegraphy it is usual to connect a siphon recorder directly to the land terminals of the cable circuit. It is desirable, therefore, to utilize in the recorder the maximum energy obtainable, the receiving magnet of the recorder should be wound to offer an impedance of the same order of magnitude as that of the cable circuit measured at its incoming terminals. For example, if the impedance of the cable circuit measured at its incoming terminals to currents at telegraphic frequency is say, 2000 ohms, the best impedance for the recorder magnet would in this case also be 2000 ohms. When such an equalization of impedances is secured, the circuit may be said to be balanced. But, if the impedances of the source and of the receiving device are greatly out of proportion, there is an unbalanced condition and a loss of available energy.

Of the various types of known amplifying devices, those in the general class of vacuum discharge repeaters such as the ionized gas type and the type known as thermionic exemplified by the "audion" have advantages with respect to amplifying very low frequency currents, since the output currents in such devices are not subject to severe distortion due to external or internal disturbances, but are substantially determined as to their form by the form of the input current. Furthermore, ionized gas repeaters of the species which make use of electromagnets for receiving incoming currents, may readily have their magnets wound to approximately the impedance of cable circuits so that they may be operated efficiently, when directly connected to the incoming terminals of such circuits. Also as to audions, it is noted that the impedance of their output circuits, although considerably higher than that of the ordinary siphon recorder used in ocean cable telegraphy is not usually so high as that of their input circuits and may, by suitable arrangements, be rendered still lower, thereby adapting the audions for direct connection to recorders. One way of lowering the output impedance is to employ a plurality of audions having their output circuits connected in parallel. In this way the impedance may be reduced sufficiently to form fairly well balanced connections with recorders. The ionized gas repeater, however, has an output circuit of the order of several hundred thousand ohms impedance, while the audion has an input circuit of similar high impedance. Such impedances are so out of proportion to that of a cable circuit or that of any practical winding for a siphon recorder, that a direct connection between the output terminals of the gaseous repeater and a siphon recorder, or one between the input terminals of an audion or even a bank of audions in multiple and a cable circuit would result in inefficient operation. Furthermore, on account of the very low frequency of the minute electric waves in cable telegraphy, these waves in certain cases as in ocean telegraphy being as low as two periods per second, it is extremely desirable to avoid the use of a transformer, the design of which for use in conjunction with vacuum discharge repeaters, such as ionized gas or thermionic repeaters or the like, between the cable and the recorder would be a very difficult matter.

The unbalanced condition and inefficient operation which would be met in the use without a transformer of any known type of vacuum discharge repeater and the necessity of using the audion, the transformer to balance impedances are at once avoided in accordance with this invention by the use of two or more vacuum discharge repeaters having different impedance characteristics and working one into the other by direct

connection. Two such vacuum discharge repeaters may be placed in series between the cable and receiver, the one connected with the cable having high output impedance and preferably also a comparatively low input impedance such as the ionized gas repeater, and the one or more connected with the receiver having high input impedance such as the audion, and preferably arranged to offer a comparatively low output impedance. The output-input circuit between two such amplifying repeaters placed in this relation including as it does high impedance paths in both, is electrically balanced and the system as a whole is well adapted for efficient amplification. Naturally the voltage and current characteristics of this high impedance output-input circuit are such that the voltage changes are high and the current changes low, in comparison with the voltage and current changes in the input circuit of the first repeater.

A system embodying the invention will be described more in detail in the following specification together with the accompanying drawings in which—

Figure 1 is a diagram of circuits as applied to an ocean cable and a recorder; and Fig. 2 is a diagram showing the application of the invention to the juncture of two cable sections where the currents received from one section are repeated in the other.

Referring to Fig. 1, the circuit of an ocean cable is represented by conductors 1 and 2 leading to an ionized gas repeater 3 and connected directly in circuit with an electro-magnet 4 thereof. A receiving device 5, which may be a siphon recorder, is provided for reproducing or recording the electric waves received through the cable. Between the repeater 3 and recorder 5 are connected a plurality of repeaters of the audion type 6, 7, 8 and 9. The output circuit of the gaseous repeater 3 is connected with the input circuit of each of the audions 6 to 9, the complete circuit being as follows: from the filaments 11, 12, 13 and 14 of the audions, through conductors 15 and 16 to an electrode 17; thence through the ionized gas in the repeater to another electrode 18, and through conductors 19 and 21, battery 22, grid 23 of audion 6, and the space between the grid and filament. Parallel paths lead through the grids and spaces in each of the audions. Batteries 24, 25 and 26 are included in extensions of the conductor 21 in order to equalize approximately the normal potential differences between the grids and filaments in the several audions, it being noted that the filaments are connected in series and fed by a battery 27, the circuit of which includes a resistance 28 to regulate the flow of current. The several plates 33, 34, 35 and 36 of the audions are connected in multiple circuit with the receiving device 5, the circuit being traced as follows: from the filaments 11, 12, 13 and 14, through conductor 37, battery 38, conductor 39, receiver 5, conductor 41, condenser 42 and conductor 43 to the several plates 33 to 36; thence in parallel through the spaces between the plates and filaments in each audion. Connected across this circuit is an impedance device 44, the coil of which serves as the path for a normal flow of direct current from the battery 38 to the several audions. This device is of high impedance so as to avoid shunting the varying currents generated in the output circuit of the audions.

A normal flow of current to the gaseous repeater 3 is supplied by battery 45, one pole of which is connected to an anode 46 and the other of which is connected through a regulating resistance 47 and conductor 48 to a cathode 49. This cathode 49, in the preferred form of the device, is of mercury and an arc is formed between the cathode 49 and the anode 46 which completes the circuit of battery 45 and causes the formation of an ionized gas (mercury) in the vessel 51. This gas renders the space conductive between the electrodes 17 and 18 and the anode 46. A normal flow of current is provided in the output circuit of the repeater 3 also from the same battery 45, the circuit extending from the negative pole of the battery 45, through the resistance 47 to conductor 52, where the circuit divides, one branch leading through impedance coil 53, conductor 16, the electrode 17, and that part of the ionized gas which lies between this electrode and the anode 46, to the positive pole of battery 45. The other branch may be traced similarly through the impedance coil 55, conductor 19, the electrode 18, and that part of the ionized gas which lies between the electrode 18 and the anode 46.

The operation is as follows: The feeble currents of low frequency received in the input circuit from the cable circuit conductors 1, 2 produce, by means of the electromagnet 4, a fluctuating magnetic field and a corresponding varying deflection of the gaseous ions to the right and left in the region of the electrodes 17, 18. This causes a corresponding varying flow of current of amplified energy in the conductors 16 and 19 and therefore in the output-input circuit between the gaseous repeater 3 and the audions 6 to 9. These audions, each of which receives a part of the energy of this current, reproduce the wave of current with amplified energy in the output circuit leading to the receiver 5. The different parts of these circuits are or may be balanced electrically in the following manner: The electromagnet 4 of the gaseous repeater 3 may be wound to any impedance desired, thus making it of an impedance of the same order of magnitude as the cable from which it

receives energy. By using a number of audions in the way shown in Fig. 1, the combined impedance of the output circuit may be made of the same order of magnitude as the receiver or siphon recorder. The output-input circuit between the gaseous repeater 3 and the audions is naturally well balanced, inasmuch as the output circuit of the gaseous repeater and the input circuit of the audions are both of high impedance and approximately of the same order of magnitude.

In Fig. 2, 61 and 62 are conductors of different cables which may terminate at the same landing point, and form sections of a common circuit. Where two-way transmission or duplex operation is desired in such a circuit, an artificial line, such as the lines 63 and 64, are provided for each conductor. Each such artificial line may comprise a resistance 65, and distributed capacity between this resistance and a ground plate 66. The cable conductor and its artificial line are joined by two condensers of large capacity 68 and 69, and at the junction point between these condensers a conductor 71 leads through suitable apparatus to ground. In applying this invention to the repeating of currents from one such cable conductor to the other, the input circuit (conductors 1 and 2) of a repeater set 60, like that of Fig. 1, may be connected in bridge between the cable conductor 61 and its artificial line 63, and a condenser 72 may be inserted in this bridge, while the output circuit (conductors 39 and 41) of the set may be connected in the ground conductor 73 of the other cable conductor 62. This provides for signaling from conductor 61 to conductor 62. For signaling in the opposite direction the arrangement is exactly similar. As shown, the input circuit (conductors 1 and 2) of a second repeater set 74, also like that of Fig. 1, is connected in bridge of the cable conductor 62 and its artificial line 64, while the output circuit (conductors 39, 41) of the set is connected in the ground conductor 71. By this arrangement messages may be transmitted in both directions simultaneously in the through circuit of the cable conductors 61 and 62, and the currents amplified at the point where the sections are united.

What is claimed is:

1. The combination with a low impedance source of varying currents and a receiver adapted to respond to such currents, of an amplifying repeater connected with said source and having an output circuit of high impedance compared to said source, and a second amplifying repeater connected between said first repeater and said receiver and having an input circuit also of high impedance compared to said source.

2. The combination with a source of varying currents and a receiver adapted to respond to such currents of an ionized gas repeater having an input electromagnet connected to said source and an output circuit including a path through the gas of said repeater, and an audion repeater connected with its input circuit in series with the output circuit of said gas repeater and its output circuit connected to said receiver.

3. The combination with a cable circuit and a receiver adapted to respond to electric waves in said circuit, of two amplifying repeaters connected in *seriatim* between said cable and said receiver, the output-input circuit between said repeaters being of high impedance compared to said cable and to said receiver.

4. The combination with a source of feeble electric waves of low frequency, and a receiver adapted to respond to said waves, of two amplifying repeaters connected in *seriatim* between said source and said receiver, one of said repeaters having an input circuit directly connected with and of impedance of the same order of magnitude as said source, the other of said repeaters having an output circuit connected with said receiver, and a circuit joining said repeaters having paths in each of high impedance compared to said source.

5. The combination with a cable circuit and a receiver adapted to respond to electric waves in said circuit, of an ionized gas repeater having an input electromagnet connected to said cable, a plurality of audion repeaters, the output circuits of which are connected in parallel with each other and in circuit with said receiver, and an output-input circuit including paths through the gas in said first-mentioned repeater and through said audion repeaters.

6. In an amplifying system, the combination of two vacuum discharge repeaters having different impedance characteristics and a connection between them whereby one works directly into the other.

7. In an amplifying system, the combination with an ionized gas repeater and a thermionic repeater, of a connection between them whereby said ionized gas repeater works directly into said thermionic repeater.

8. The combination of a thermionic repeater and a vacuum discharge repeater working directly into said thermionic repeater, the said repeaters having different impedance characteristics.

9. The combination of a plurality of thermionic repeaters in multiple having a common output line and a vacuum discharge repeater working into said thermionic repeaters.

10. The combination of a line of low impedance, of a vacuum discharge repeater having a high output impedance, and a second vacuum discharge repeater into which

said first mentioned repeater works, said second repeater having an input impedance of the same order of magnitude as the output impedance of the first mentioned repeater.

11. The combination of a plurality of thermionic repeaters in multiple having a common output line, and an ionized gas repeater working into said thermionic repeaters.

12. The combination of a line of low impedance, of an amplifying repeater having its input circuit directly connected to said line, and a second amplifying repeater into which said first mentioned repeater works the output-input circuit between said repeaters including high impedance paths in each repeater.

13. The combination with an incoming and an outgoing line of low impedance, of a set of repeaters directly connected in *serie* between said lines, the output-input circuit between said repeaters being of high impedance with respect to said lines.

In witness whereof, I hereunto subscribe my name this 3rd day of April A. D., 1914.

EDWIN H. COLPITTS.

Witnesses:

KATHERINE L. STAHL,

NORAH E. TUTHILL.

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PAGE

1468

E. H. COLPITTS.

SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE.

APPLICATION FILED MAY 16, 1914.

1,137,384. Patented Apr. 27, 1915.

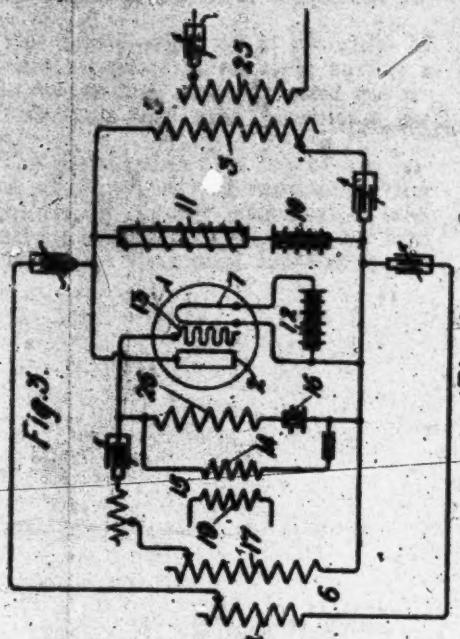


Fig. 3.

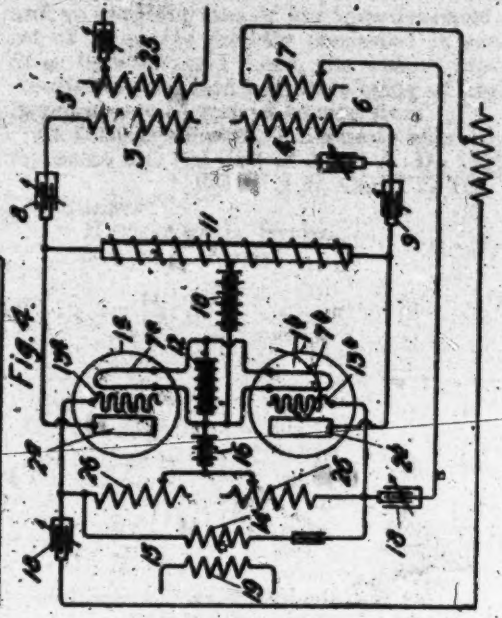


Fig. 4.

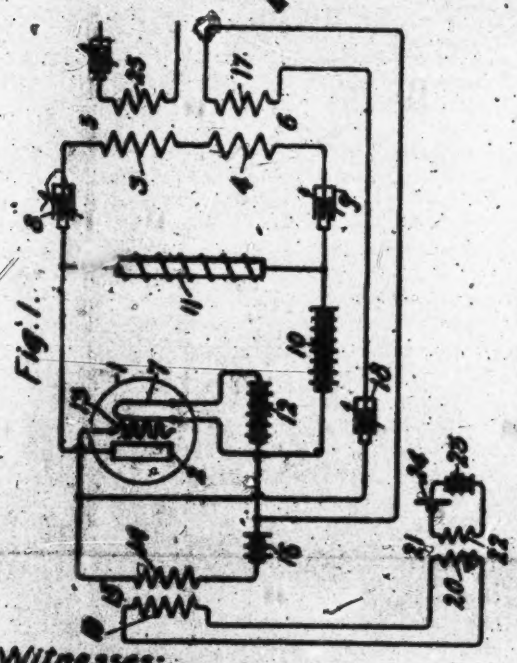


Fig. 1.

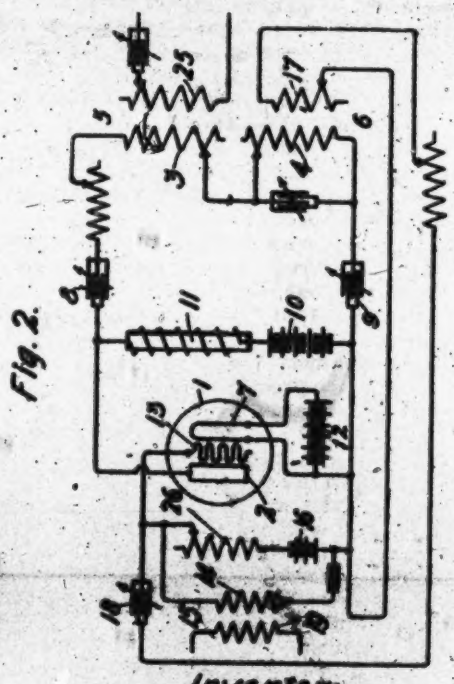


Fig. 2.

Witnesses:

C. M. Tuttle

John Waldheim

Inventor:

Edwin H. Colpitts.

by A. C. Fennel. Atty.

UNITED STATES PATENT OFFICE.

EDWIN H. COLPITTS, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE.

REISSUED

1,137,884. Specification of Letters Patent. Patented Apr. 27, 1915.

Application filed May 18, 1914. Serial No. 839,218.

To all whom it may concern:

Be it known that I, EDWIN H. COLPITTS, a subject of the King of Great Britain, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Systems for the Transmission of Intelligence.

This invention relates to systems for the transmission of intelligence, in which the amplitudes of successive electrical oscillations of high frequency are varied in accordance with the lower frequency forms of the messages delivered.

Its object is to simplify the mechanism and to strengthen the effectiveness of the apparatus required for the production of the modulated oscillations.

To these ends the invention embodies a repeater which serves not only as a generator of high frequency oscillations, but also as a means for modulating the oscillations in accordance with the low frequency signaling impulses to be transmitted.

The invention is adapted for embodiment in systems of wireless telegraphy and telephony in so-called high frequency wired systems, and in general wherever a receiving device is rendered sensitive to signaling impulses or waves of low frequencies by means of sustained electric or electromagnetic waves of high frequency transmitted from the sending station.

The single device used to perform the two functions referred to may be a repeater, preferably a repeater of the audion type, wherein the output circuit is connected with the input circuit, this arrangement, with proper adjustment of devices in the circuit, resulting in the production of sustained high frequency oscillations. By varying the potential in the input circuit, as for example by connecting a transmitter or other device for sending a message in circuit with one of the electrodes, say the grid, of the audion, the sustained oscillations, it has been found, are then modulated in accordance with the message to be sent. The message may be received or recorded in any desired manner at the distant station.

Several embodiments of the invention will be set forth in the following detail description taken in connection with the accompanying drawings, wherein—

Figure 1 illustrates a system of circuits embodying the invention; and Figs. 2, 3 and 4 are modified circuits therefor.

Like parts are designated alike in the several figures.

Referring first to Fig. 1, an audion 1, the elements of which are inclosed in an evacuated vessel, as usual, is arranged with its output anode or plate 2 connected through the primary windings 3 and 4 of repeating coils 5 and 6 to the negative terminal of the heated filament or cathode 7 of the audion. Included in this output circuit may be located a battery 10 and, as required, adjustable devices such as the condensers 8 and 9. Bridged across the circuit, to feed battery current to the plate 2, is a coil of high impedance 11. The filament 7 is heated by current from the battery 12. The input electrode or grid 13 of the audion is connected through the secondary winding 14 of a repeating coil 15 to the negative terminal of the filament 7, and included in this the input circuit, there may be located a battery 16. The secondary winding 17 of the repeating coil 6 is connected through an adjustable condenser 18 with the input circuit, one wire leading to the grid 13 and the other wire to the negative terminal of the filament 7.

The primary winding 19 of the repeating coil 15 may be connected in circuit with the secondary winding 20 of another repeating coil 21, the primary winding 22 of which is connected in circuit with a battery 23 and a sending device, which, as shown, may be a telephone transmitter 24. The repeating coil 5 has a secondary winding 25, the terminals of which lead to the antenna of a wireless system or to the line of a wire circuit, according to the particular use to which the apparatus is put.

The operation of the system illustrated in Fig. 1 is as follows: The audion 1 is rendered active by the heated filament 7, which emits a stream of negative ions across the space intervening between it and the positively charged plate 2. This stream passes through the interspaces of the grid. The battery 10, acting through the resistance of the coil 11, tends to maintain a steady flow of current in the output circuit, including the ionized space between the plate 2 and the filament 7. The flow of current across the ionized space, however, is not steady but is caused to

fluctuate at a very high frequency, by reason of the interaction between the input and output circuits through the repeating coil 6. The frequency of the sustained oscillations produced by this arrangement may be varied by adjusting the capacities of the various condensers in the circuit. The high frequency currents in the output circuit are transmitted by the repeating coil 5 into the line or antenna to which the secondary winding 5b may be connected.

By means of the telephone transmitter 24, the amplitude of the sustained oscillations is modified or modulated in accordance with sound waves which are of a lower order of frequency. This may be explained as follows: At the normal potential of the battery 16 impressed on the grid 13, the sustained oscillations are produced at a constant amplitude. At a higher potential, due to a positive impulse from the winding 14, the current in the output circuit is increased, and the amplitude of the high frequency oscillations is greater. Conversely, at a lower potential, due to a negative impulse, the oscillations become lesser in amplitude than normal. Thus each pulsation of potential, caused by speaking into the transmitter 24, is effective in producing a corresponding variation in the amplitude of oscillations of current, and therefore of energy in the output circuit and likewise in the line or antenna.

In Fig. 2 is shown an arrangement differing from that of Fig. 1 in that the battery 16 thereof, corresponding to the like numbered battery in Fig. 1, is connected in series with the high impedance coil 11 in bridge of the output circuit. The arrangement is also different in that the battery 16 is included in a bridge of the input circuit in series with an adjustable resistance 26.

In Fig. 3 is illustrated a modified circuit in which the battery 10 is included in series with the high impedance coil 11 as it is in Fig. 2, but primary windings 3 and 4 of the repeating coils 5 and 6 are connected in parallel with relation to each other instead of in series as in Figs. 1 and 2.

In Fig. 4 an arrangement is shown in which two audions 1^a and 1^b are used. Here the battery 10 is connected to a central point in the winding of the high impedance coil 11, the outer terminals of which are connected to the two plates 2^a and 2^b, respectively, of the two audions. Battery 16 is likewise connected to a midpoint of an adjustable resistance 26, the outer terminals of which are connected to the two grids 13^a and 13^b. In the system of Fig. 4, therefore, the battery 10 tends to supply a steady flow of current through both audions from the plates 2^a and 2^b to the two filaments 7^a and 7^b, respectively. The battery 12 supplies current to both of the filaments 7^a and 7^b. The operation is such that the impulses from the repeating coils 6 and 15 produce at any instant of time opposite potential variations on the grids 13^a and 13^b, and these opposite potential variations produce an effect which is cumulative in the output circuit to which the plates 2^a and 2^b are connected.

What is claimed is:

1. The combination with a generator of high frequency current, comprising a repeater and an input and an output circuit therefor united with each other, said repeater having an electrode located in said input circuit; of a transmission line united with said output circuit, and a source of low frequency potential variations connected to said electrode.

2. The combination with an audion having a filament, a plate and a grid, an input circuit connected with the grid and an output circuit connected with the plate; of an inductive connection between said output and said input circuits adapted to the production by said audion of sustained high frequency oscillations, and a sending device, adapted for producing signaling impulses of low frequencies, connected with said input circuit.

3. The combination with a generator of high frequency current, comprising a repeater, an input and an output circuit therefor and a connection between said circuits; of a transmission line united with said output circuit, and a sending device, adapted for producing signaling impulses of low frequencies, connected with said input circuit.

4. The combination with a generator of high frequency current, comprising an evacuated vessel, means for producing a state of ionization in said vessel, and an input and an output circuit interconnected to react upon each other; of means connected with said input circuit for producing low frequency potential variations in said input circuit.

5. The combination with a generator of high frequency current, comprising an evacuated vessel, means for producing a state of ionization in said vessel, and an input and an output circuit inductively connected with each other; of a source of low frequency potential variations connected with said input circuit for controlling the amplitude of the high frequency currents developed by said generator.

6. The combination with a generator of high frequency current, comprising an evacuated vessel, means for producing a state of ionization in said vessel, and an input and an output circuit connected with each other; of means included in said circuits for adjusting the frequency of said current; and a source of low frequency potential variations connected with said input

circuit for controlling the amplitude of the high frequency currents developed by said generator.

7. In apparatus of the kind described, the combination of an evacuated vessel and means, including a cathode, for producing a state of ionization in said vessel; of an input anode and an output anode in said vessel; an output circuit connected to said output anode and including an adjustable condenser and a source of continuous current, an input circuit connected to said input anode and inductively connected to said output circuit and means connected with said input circuit for producing low frequency potential variations in said input circuit.

8. The combination with an audion having an input circuit and an output circuit inductively connected with each other; of means connected with said input circuit for producing low frequency potential variations in said input circuit.

In witness whereof, I hereunto subscribe my name this 15 day of May A. D., 1914.

EDWIN H. COLPITTS.

Witnesses:
R. Eglin,
Katherine L. Stahl.

1472

G. A. CAMPBELL.
ELECTRIC WAVE FILTER.
APPLICATION FILED JULY 15, 1915.

1,227,113. Patented May 22, 1917.
3 SHEETS—SHEET 1.

Fig. 1

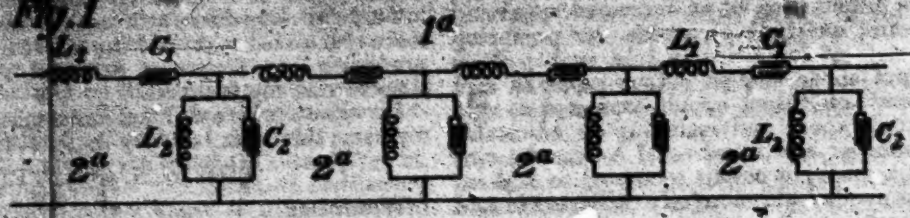


Fig. 2

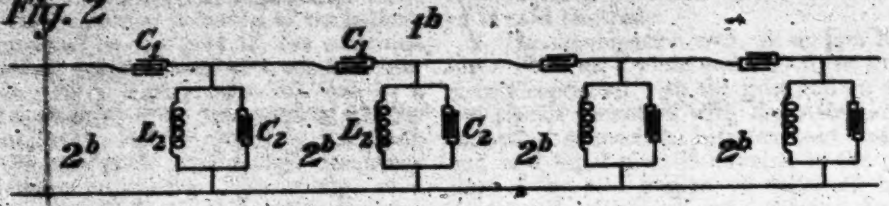


Fig. 3

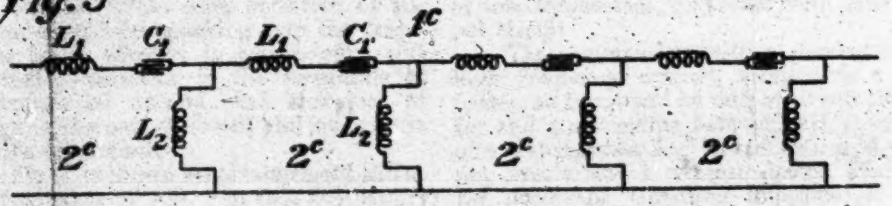


Fig. 4

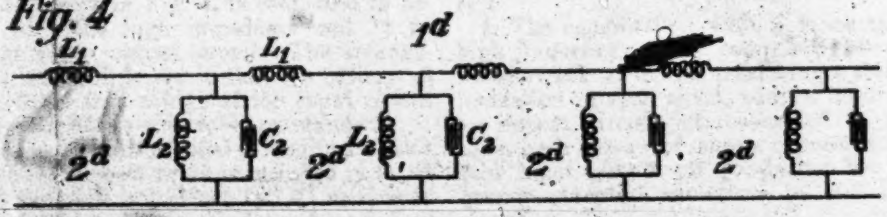
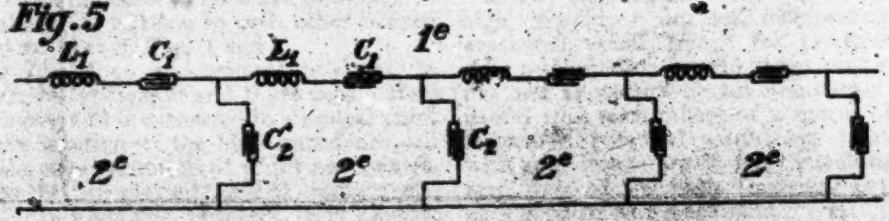


Fig. 5



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ELECTRIC WAVE FILTER.
APPLICATION FILED JULY 18, 1915.

1,227,118. Patented May 22, 1917.

3 SHEETS—SHEET 2.

Fig. 6

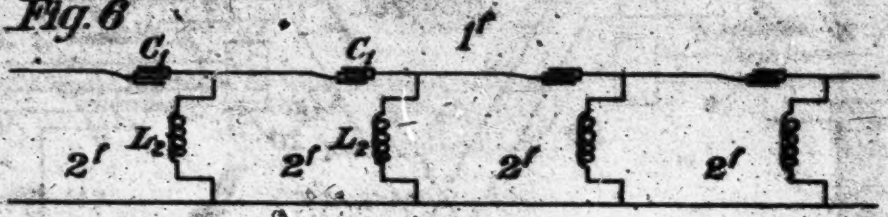


Fig. 7

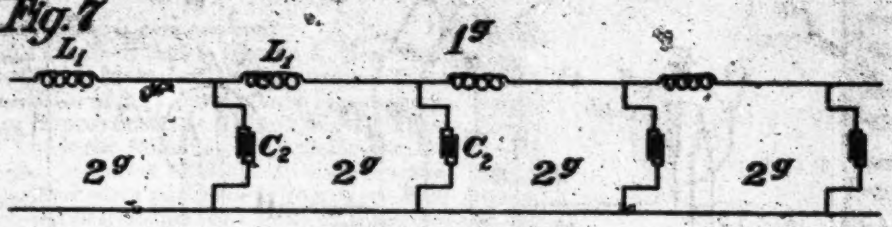


Fig. 8

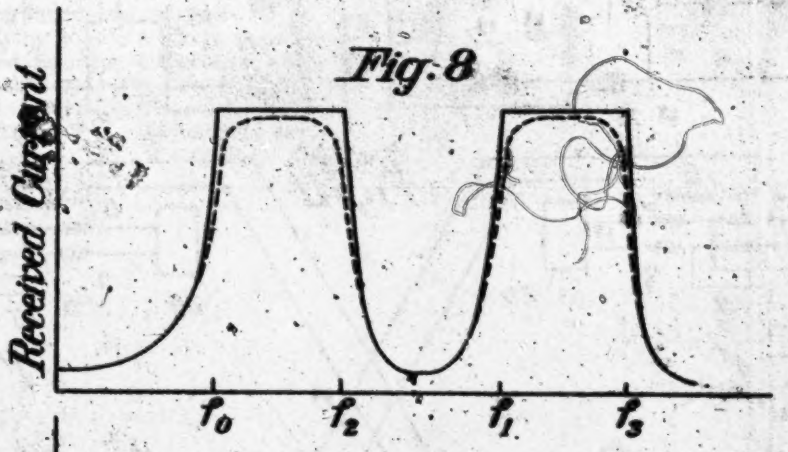
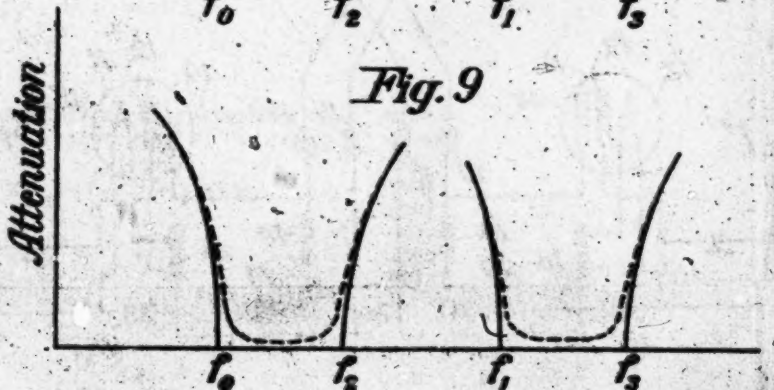


Fig. 9



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ELECTRIC WAVE FILTER.
APPLICATION FILED JULY 15, 1915.

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3 SHEETS—SHEET 3.

Fig. 10

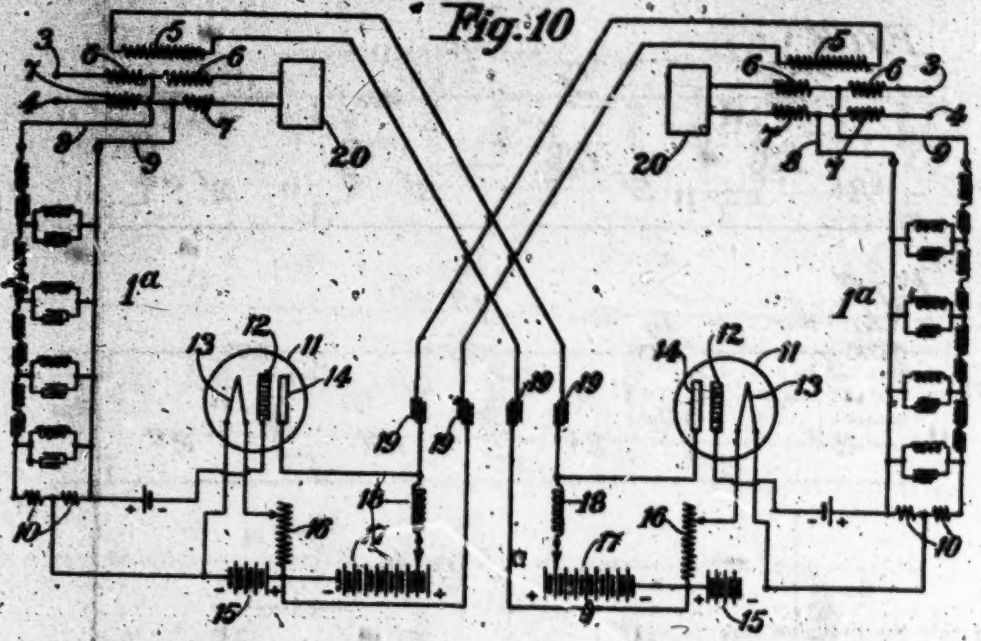
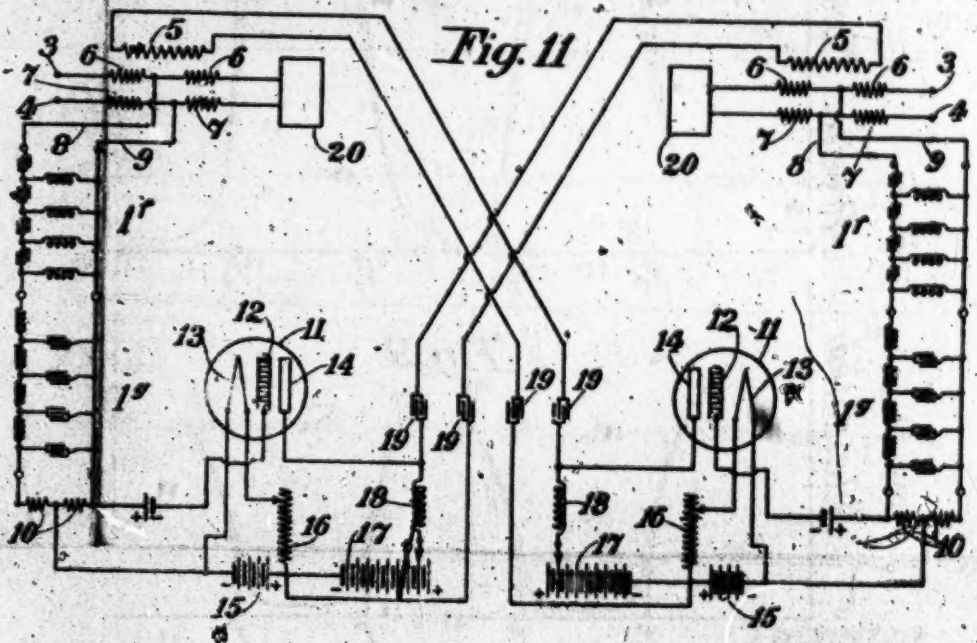


Fig. 11



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UNITED STATES PATENT OFFICE.

GEORGE A. CAMPBELL, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC WAVE-FILTER.

1,227,113. Specification of Letters Patent. Patented May 22, 1917.

Application filed July 15, 1915. Serial No. 40,057.

To all whom it may concern:

Be it known that I, GEORGE A. CAMPBELL, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain Improvements in Electric Wave-Filters, of which the following is a specification.

This invention relates to an electric wave-filter and more particularly to a wave-filter adapted to transmit with small or negligible attenuation sinusoidal currents of all frequencies lying within a range or ranges of preassigned limiting frequencies while attenuating and approximately extinguishing sinusoidal currents of frequencies lying outside the limits of the preassigned range or ranges.

My invention, though it may find expression in many embodiments, has common to all the broad idea of a wave-filter in the nature of a connecting line having an impedance element or elements in series with the line and an impedance element or elements in shunt across the line, the values of the impedance elements being so proportioned that the structure will transmit, with small or negligible attenuation, from a source of electromagnetic energy to an electrical receiving, translating or repeating device, sinusoidal currents of all frequencies lying within specified and preassigned limits or ranges while attenuating and sensibly extinguishing currents of all frequencies lying outside such limits.

My invention in one or more of its embodiments has important applications in connection with wireless telegraphy, wireless telephony, multiplex high frequency wire telephony, composite telegraph and telephone lines, and in particular with telephone repeater circuits, wherein it is highly important that means be provided for selecting a range or band of frequencies, such as, for instance, the range or band of frequencies necessary for intelligible telephonic transmission of speech, while at the same time excluding from the receiving or translating device currents of all other frequencies.

My invention is illustrated in the accompanying drawings in which Figure 1 is a diagram illustrating the broad form of my invention from which all specific embodiments may be derived by assigning proper values to the electrical constants of the structure; Figs. 2, 3, 4, 5, 6 and 7 are diagrams illustrating different embodiments of my invention; Figs. 8 and 9 show curves illustrating the characteristic performance of the wave-filter; and Figs. 10 and 11 are diagrams showing my invention embodied in telephone repeater circuits.

Like reference characters refer to like parts throughout the several figures of the drawings.

Referring to Figs. 1 to 7 inclusive, each wave filter 1^a, 1^b, 1^c, 1^d, 1^e, 1^f, 1^g is composed of a plurality of identical sections 2^a, 2^b, 2^c, 2^d, 2^e, 2^f, 2^g, respectively, each including lumped impedance in series with the line and lumped impedance in shunt across the line. Said impedance may be provided by condensers, C_1, C_2 or by inductance coils L_1, L_2 or by a suitable combination of both, there being at least, for each section of the wave-filter, an inductance element in series with the line and a capacity element in shunt across the line or vice versa. Thus in Fig. 1 showing the preferred embodiment of the invention, there are, for each section, both a condenser C_1 and an inductance coil L_1 in series with the line and a condenser C_2 and an inductance coil L_2 in parallel in shunt across the line. In said figures, as well as in the other figures of the drawing, the reference characters C_1 and C_2 are used to designate similar elements, that is condensers, the subscript 1 affixed to the reference letter indicating that the element is in series with the line and the subscript 2 indicating that the element is in shunt across the line. In like manner the reference characters L_1 and L_2 are used to indicate in-

ductance coils in series with the line and in shunt across the line, respectively.

In Figs. 2 to 7 inclusive, said impedance elements for each section are included as follows:—in Fig. 2 there is a condenser in series with the line and a condenser and an inductance coil in parallel in shunt across the line; in Fig. 3, a condenser and an inductance coil in series with the line and an inductance coil in shunt across the line; in Fig. 4 an inductance coil in series with the line and a condenser and an inductance coil in parallel in shunt across the line; in Fig. 5, a condenser and an inductance coil in series with the line and a condenser in shunt across the line; in Fig. 6, a condenser in series with the line and an inductance coil in shunt across the line; and, in Fig. 7, an inductance coil in series with the line and a condenser in shunt across the line. Said Figs. 1 to 7 inclusive, merely show typical forms of the invention and are not intended to illustrate all of the possible modifications thereof.

By assigning suitable values to the condensers C_1, C_2 and the inductance coils L_1, L_2 in said Figs. 1 to 7 inclusive, the structure, if inserted as a connecting line between a source of electromagnetic energy and an electrical receiving, translating or repeating device, will transmit to the latter sinusoidal currents lying within preassigned ranges or bands and will at the same time effectively protect the receiving, translating or repeating device from currents of frequencies lying outside the preassigned ranges of frequencies.

The fundamental principles underlying my invention and the manner of applying the same so as to provide a structure embodying the invention will now be set forth.

It is a well known fact that, in a uniform transmission line containing uniformly distributed resistance, inductance and capacity, the attenuation of current along the line is a phenomenon which is caused by resistance dissipation and becomes zero when the resistance becomes zero. In a periodic structure, however, containing lumped series impedance and lumped shunt impedance, high attenuation may exist even when the resistance is practically zero. This attenuation is due not to resistance dissipation but to involved reactions among the impedance units of the structure. The reactions and interactions, taking place in the structure and determining the character of the attenuation attending transmission of periodic currents, are so involved as to make desirable the use of mathematical formula in elucidating the laws governing the electromagnetic phenomena taking place in the structure and in particular in laying down rules of design whereby any one, skilled in the art, may construct the electric wave-filter of this invention.

For the purpose of deriving the mathematical formulæ pertaining to the theory of my invention, assume a structure consisting of a series of sections, each section having an impedance Z_1 in series with the line, and an impedance Z_2 in shunt across the line. Letting J_n denote the circuital current flowing in the nth section of the structure, J_{n-1} the current flowing in the $(n-1)$st section, and J_{n+1} the current flowing in the $(n+1)$st section, and applying Kirchhoff's law to said currents and circuits, it follows that:—

$$Z_1 J_n + Z_2(J_n - J_{n+1}) + Z_2(J_n - J_{n-1}) = 0.$$

By various rearrangements this equation may be written as,

$$\frac{J_{n+1}}{J_n} + \frac{J_{n-1}}{J_n} = \frac{Z_1}{Z_2} + 2$$

The last foregoing equation is a difference equation and, under the principles of the calculus of finite differences, the ratio of

$$\frac{J_{n+1}}{J_n}$$

is equal to the ratio of

$$\frac{J_n}{J_{n-1}},$$

the equality of said ratio holding for propagation in either direction. If this ratio is set equal to ϵ^{Γ} without specifying the value of Γ, it follows that for propagation in either direction:

$$\frac{J_{n-1}}{J_n} = \epsilon^{\Gamma} \text{ and } \frac{J_{n+1}}{J_n} = \epsilon^{-\Gamma} \quad (1)$$

In the foregoing equations, ϵ denotes the base of Naperian logarithms, and Γ denotes the propagation constant of the structure. The value of Γ is, so far, unknown but may be determined by substitution of the above values of

$$\frac{J_{n+1}}{J_n}$$

and

$$\frac{J_{n-1}}{J_n}$$

in th above difference equation, whence,

$$\epsilon^{\Gamma} + \epsilon^{-\Gamma} = \frac{Z_1}{Z_2} + 2$$

or,

$$\cosh \Gamma = \frac{1}{2}\left(\frac{Z_1}{Z_2}\right) + 1 \quad (2)$$

Referring to equation (1), if Γ is not a pure imaginary, the current value is dimin-

ished or attenuated in transmission from the nth section to the $(n+1)$st section. If Γ is a pure imaginary, the absolute values of J_n and $J_{(n+1)}$ are equal, and hence the current suffers no attenuation in transmission from section to section but only a change of phase. The condition, then, for unattenuated transmission is that Γ shall be a pure imaginary. It may be shown from equation (2) that the condition for unattenuated transmission is that

$$\frac{1}{2}\left(\frac{Z_1}{Z_2}\right)+1 \text{ shall lie between } \pm 1. \quad (3)$$

Hence the limiting values of the frequency for free transmission are given by:—

$$\left.\begin{array}{l} \frac{Z_1}{Z_2}=0 \\ Z_1=-4Z_2 \end{array}\right\} \quad (4)$$

For the structure shown in Fig. 1, it is evident that the series impedance

$$Z_1=\frac{1-L_2C_2p^2}{pC_2};$$

and the shunt impedance

$$Z_2=\frac{iL_2p}{1-L_2C_2p^2}$$

In these formulæ p is $2\pi f$ where f is the frequency in cycles per second, and i is the imaginary quantity

$$\sqrt{-1}.$$

Referring to the expressions for Z_1 and Z_2 above given, it is evident that equations (4) have as the variable or unknown the value of p. There are four roots or four values of p which will satisfy said equations (4), which roots will be denoted by the symbols p_0, p_1, p_2 and p_3. Said roots have the following values:—

$$p_3=\frac{1}{\sqrt{2L_1C_2}}\sqrt{4+\frac{L_2}{L_2}+\frac{C_2}{C_1}+\sqrt{\left(4+\frac{L_2}{L_2}+\frac{C_2}{C_1}\right)^2-4\frac{L_2C_2}{L_2C_1}}} \quad (5)$$

$$p_0=\frac{1}{\sqrt{2L_1C_2}}\sqrt{4+\frac{L_2}{L_2}+\frac{C_2}{C_1}-\sqrt{\left(4+\frac{L_2}{L_2}+\frac{C_2}{C_1}\right)^2-4\frac{L_2C_2}{L_2C_1}}} \quad (6)$$

$$p_1=\frac{1}{\sqrt{L_1C_1}} \quad (7)$$

$$p_2=\frac{1}{\sqrt{L_2C_2}} \quad (8)$$

It will be observed that these four limiting values of p or $2\pi f$ are in geometrical proportion, and that:—

$$\frac{p_3}{p_1}=\frac{p_2}{p_0} \quad (9)$$

An examination of equations (4) to (9) inclusive shows that the unattenuated frequencies lie in two distinct, continuous bands or ranges. If $p_1>p_2$, the frequencies of unattenuated transmission lie between $p_3/2\pi$ and $p_1/2\pi$ for the upper band and between $p_2/2\pi$ and $p_0/2\pi$ for the lower band. If, on the contrary, $p_1<p_2$, the frequencies for the upper band lie between $p_3/2\pi$ and $p_2/2\pi$, and for the lower band between $p_1/2\pi$ and $p_0/2\pi$.

Equations (5) to (9) inclusive are fundamental to my invention and by their aid the electrical constants of the wave-filter of my invention may be determined. From said fundamental equations, simplified formulæ for different structural embodiments of the invention may be derived, as will hereinafter be pointed out.

Referring to the drawings, Figs. 8 and 9 show the character of transmission through the structure illustrated in Fig. 1. In said Figs. 8 and 9, f_0, f_2, f_1, f_3, represent frequencies corresponding to p_0, p_2, p_1, p_3, respectively. In Fig. 8, the ordinates are received currents while the abscissæ are frequencies. Fig. 9 has as its ordinates attenuation values per section and as abscissæ frequencies. The full line curves refer to the ideal structure in which the resistance of the impedance units is quite negligible, while the broken line curves show the departure from the ideal case due to resistance in the structure. In any case the resistances are made sufficiently small to be practically negligible.

It is not always desirable to transmit two bands of frequencies, and as a further refinement, my invention also contemplates a wave-filter which will transmit freely all frequencies lying within a single band of specified limits. As will hereinafter be more fully set forth, the structures shown in Figs. 2 to 7 inclusive will function as a single band wave-filter, and the structure shown in Fig. 1 may be made to so function.

Reference to Fig. 8 and to equations (5), (6), (7) and (8), shows clearly that if the two bands of free transmission are made to coalesce or merge into one by setting $f_1=f_2$, or if one of the bands is pushed out or relegated either to infinity or to zero, there remains one single band of free transmission for finite frequencies. The first form of single band wave-filter is attained by mak-

ing $f_1=f_2$ or $L_1C_1=L_2C_2$. This form will be referred to as a filter having coalescent or confluent bands.

The second method of realizing a single band wave-filter is attained by relegating the upper band to infinity or the lower band to zero. Reference to equations (5), (6), (7) and (8), shows that one band is relegated to infinity if L_1 or $C_1=0$; while the other band is relegated to zero if L_2 or $C_2=\infty$. Obviously, from the foregoing, the single band may also be attained by making $L_1=C_2=0$, or by making $L_2=C_1=\infty$. It will be understood, of course, that an infinite inductance or a zero capacity are equivalent to an infinite impedance, and, hence, a circuit through the same may be regarded as replaced by an open circuit; on the other hand a zero inductance or an infinite capacity are equivalent to a zero impedance, and, hence, they may be regarded as in effect short circuited.

It thus appears that there are, in general, seven ways of reducing the double band wave-filter to a single band wave-filter, namely:

(*a*) Making the two broad bands coalescent or confluent by setting $L_1C_1=L_2C_2$;

(*b*) Relegating one band to infinity by making $L_2=0$;

(*c*) Relegating one band to infinity by making $C_2=0$;

(*d*) Relegating one band to zero by making $C_1=\infty$;

(*e*) Relegating one band to zero by making $L_2=\infty$.

(*f*) Making $L_1=C_2=0$ and thereby transmitting freely all frequencies above a specified value;

(*g*) Making $L_2=C_1=\infty$ and thereby transmitting all frequencies below a specified value.

Design formulæ will now be given by applying which any one skilled in the art may construct a wave-filter which will freely transmit a definite, preassigned band or definite, preassigned bands of frequencies while attenuating all frequencies lying outside these bands.

Considering first the general form of the double band wave-filter, let it be required to design a filter which shall freely transmit all frequencies lying between the limiting frequencies f_3 and f_1 and also between f_2 and f_0 with the provision that

$$f_3>f_1>f_2>f_0$$

and

$$\frac{f_3}{f_1}=\frac{f_2}{f_0}.$$

The formulæ determining the relations obtaining among the electrical constants are deducible from equations (5), (6), (7) and (8), and are as follows:—

$$L_1C_1=\left(\frac{1}{2\pi f_1}\right)^2 \quad \text{(I)}$$

$$L_2C_2=\left(\frac{1}{2\pi f_2}\right)^2 \quad \text{(II)}$$

$$\frac{L_2}{L_1}=\frac{1}{4}\left(\frac{f_1}{f_0}\right)^2\left[1-\left(\frac{f_0}{f_1}\right)^2\right]\left[1-\left(\frac{f_0}{f_2}\right)^2\right] \quad \text{(III)}$$

or

$$\frac{L_2}{L_1}=\frac{1}{4}\left(\frac{f_2}{f_3}\right)^2\left[1-\left(\frac{f_3}{f_1}\right)^2\right]\left[1-\left(\frac{f_3}{f_2}\right)^2\right] \quad \text{(IV)}$$

Formulæ III and IV are equivalent. A structure so designed or proportioned that its electrical constants satisfy formulæ (I), (II) and (III), or (I), (II) and (IV), complies with the above stated requirements for freely transmitting frequencies lying between f_3 and f_1, constituting one band and between f_2 and f_0, constituting the second band, while attenuating and sensibly extinguishing currents of all frequencies lying outside these bands.

The rules of design of the single band wave-filter will now be considered, the different cases, hereinbefore stated, being treated in order.

(*a*) Confluent bands, in which case $L_1C_1=L_2C_2$. This form is shown in Fig. 1, it being understood that the structure shown in said figure may be made to function as a single band wave-filter by making $L_1C_1=L_2C_2$, that is by causing the two bands to coalesce. If the frequencies to be freely transmitted are to lie between the upper limiting frequency f_3 and the lower limiting frequencies f_0, the design formulæ are:

$$L_1C_1=L_2C_2=\left(\frac{1}{2\pi f_3}\right)\left(\frac{1}{2\pi f_0}\right) \quad \text{(I}^a\text{)}$$

$$\frac{L_2}{L_1}=\frac{1}{4}\left(\frac{f_0}{f_3}\right)\left(\frac{f_3}{f_0}-1\right)^2 \quad \text{(II}^a\text{)}$$

(*b*) Relegating one band to infinity by making $L_1=0$ in which case the structure of the wave-filter assumes the form shown in Fig. 2. If the limiting frequencies of free transmission are f_3 (upper limit) and f_0 (lower limit), the design equations for this form are:—

$$L_2C_2=\left(\frac{1}{2\pi f_3}\right)^2 \quad \text{(I}^b\text{)}$$

$$\frac{C_1}{C_2}=\frac{1}{4}\left[\left(\frac{f_3}{f_0}\right)^2-1\right] \quad \text{(II}^b\text{)}$$

(*c*) Relegating one band to infinity by making $C_2=0$, in which case the structure of the wave-filter assumes the form shown in Fig. 3. If the limiting frequencies of free transmission are f_1 (upper limit) and f_0

(lower limit) the design formulæ for this form are:—

$$L_1C_1=\left(\frac{1}{2\pi f_1}\right)^2 \qquad (I^c)$$

$$\frac{L_2}{L_1}=\frac{1}{4}\left[\left(\frac{f_2}{f_1}\right)^2-1\right] \qquad (II^c)$$

(*d*) Relegating one band to zero by making $C_1=\infty$, in which case the wave-filter is of the form shown in Fig. 4. Let the limiting frequencies be f_1 and f_2 and the design formulæ are:

$$L_2C_2=\left(\frac{1}{2\pi f_2}\right)^2 \qquad (I^d)$$

$$\frac{L_2}{L_1}=\frac{1}{4}\left[\left(\frac{f_2}{f_1}\right)^2-1\right] \qquad (II^d)$$

(*e*) Relegating one band to zero by making $L_2=\infty$, in which case the wave-filter assumes the form shown in Fig. 5. Let the limiting frequencies of free transmission be f_2 and f_1 and the design formulæ are:

$$L_1C_1=\left(\frac{1}{2\pi f_1}\right)^2 \qquad (I^e)$$

$$\frac{C_1}{C_2}=\frac{1}{4}\left[\left(\frac{f_2}{f_1}\right)-1\right] \qquad (II^e)$$

(*f*) Making $L_2=C_2=0$, in which case the wave-filter assumes the form shown in Fig. 3 and freely transmits all frequencies above a definite inferior limit. If the inferior limit is specified as f_0, the design formula is:

$$L_2C_1=\frac{1}{4}\left(\frac{1}{2\pi f_0}\right)^2 \qquad (I^f)$$

(*g*) Making $L_2=C_1=\infty$, in which case the wave-filter assumes the form shown in Fig. 7 and freely transmits all frequencies below a specified superior limit. If the superior limiting frequency is specified as f_3, the design formula is:

$$L_1C_2=4\left(\frac{1}{2\pi f_3}\right)^2 \qquad (I^g)$$

It will be observed from the foregoing design formulæ that there is always one impedance element whose value is a matter of choice. The value of this element may be determined from convenience of design or may be made to satisfy some other specified requirement, such as, for instance, that the line shall have a definite impedance at a particular frequency. It is further evident that the particular form of single band wave-filter is a matter of choice and the selection of any particular form may be left to the requirements of a particular design.

It will further be understood that the number of sections of the wave-filter will depend on the degree to which it is desired to extinguish the currents to be filtered out. If the number of sections is doubled the ratio of the current of any particular frequency entering the filter to the current of that frequency leaving the filter is approximately squared.

It should be clearly understood that my invention differs fundamentally both in structure and function from loaded transmission line systems. In transmission lines in which loading coils may advantageously be inserted, the attenuation is excessive and the sole purpose and object of loading is to reduce the attenuation which normally exists in the unloaded line. Moreover said organizations are strictly dependent for their utility upon the proper spacing of the loading elements such as inductance coils or condensers with reference to the electrical wave length of the line. In the present invention, however, the line in which the impedance elements are inserted is so short that normally the attenuation is absolutely negligible, that is, there is no observable attenuation except when the impedance elements are inserted in accordance with my invention. When, however, the impedance elements are so inserted, the normally non-attenuating line sharply attenuates currents of preassigned frequencies while freely transmitting currents of other frequencies. My invention is therefore not concerned with the spacing of the impedance elements with reference to the electrical wave length since said entire line is so short as normally to extend over only a minute fraction of a wave length, but is directed to the proper proportioning of said impedance elements. In brief my invention is directed to introducing in a line normally of negligible attenuation, impedance elements so proportioned as to render said line attenuating for certain specified or preassigned ranges of frequencies.

As an example of the application of the foregoing design formulæ, let it be required to design a filter which shall transmit all frequencies lying between 200 and 2000 cycles per second. Any one of the forms shown in Figs. 1, 2, 3, 4, 5 may be employed or the two forms shown in Figs. 6 and 7 connected in series. Let it be assumed that convenience or other considerations lead to the selection of the type of wave-filter shown in Fig. 1. Applying design formulæ (I^c) and (II^c), applicable to this type of single band wave-filter, and substituting therein for f_1 and f_2 the above assigned values 200 and 2000, respectively:

$$L_1C_1=L_2C_2=\left(\frac{1}{2\pi 2000}\right)\left(\frac{1}{2\pi 200}\right)=(.635)\,10^{-7}$$

and

$$\frac{L_2}{L_1}=\frac{1}{4}\left(\frac{200}{2000}\right)\left(\frac{2000}{200}-1\right)^2=2.025$$

Therefore the above stated requirements are satisfied if

$$L_1C_1=L_2C_2=(.635)\,10^{-3}$$

and

$$\frac{L_2}{L_1}=2.025.$$

As has been hereinbefore stated, one of the constants L_1, C_1, L_2, C_2 is arbitrary. Let it be assumed that convenience or other considerations dictate a value of 1 henry for L_2. The values of the several impedance elements are then as follows: $L_2=1$ henry; $L_1=0.494$ henry; $C_1=(1.29)\,10^{-3}=0.129$ microfarad; and $C_2=0.0635$ microfarad.

Therefore the wave-filter shown in Fig. 1 having its impedance elements of the values above derived will transmit freely currents of all frequencies lying between 200 and 2000 cycles per second. The attenuation constant per section at a frequency of 2200 cycles per second, for example, is found from equation (2) by computation to be .98. Hence, from equation (1), the ratio of currents in adjacent sections is 2.67 approximately, and if five sections are employed the current of 2200 cycles in the 5th section is less than 2% of its value in the first section, while currents of frequency lying between 200 and 2000 cycles per second are practically unattenuated.

Fig. 10 shows my invention, as embodied in the type shown in Fig. 1, employed in combination with vacuum tube repeater circuits. It is to be understood that the embodiments of my invention shown in Figs. 2, 3, 4 and 5 might be equally well employed. In said Fig. 10, a two-way two-repeater set consisting of two symmetrical halves is shown, and hence the same parts in the two halves of the set are designated by the same reference characters. The terminals 3, 4 and 3, 4 connect the repeater set in series with the through telephone line (not shown). At each end of the set are the secondary windings 6, 6 and 7, 7 of a repeating coil, of which the windings 5 constitute the primaries. Across the middle of the windings 6, 6 and 7, 7 are connected the conductors 8, 9 which lead to the filters 1^a. The other end of each filter is closed by a non-inductive resistance 10. The vacuum tube repeaters 11 are of a well-known type comprising a grid 12, filament 13, and plate 14. The input side of the repeater 11 is shown as bridged across half of the non-inductive resistance 10. The battery 15 heats the filament 13 through the adjustable resistance 16. Across the filament 13 and plate 14 is bridged the battery 17 in series with the high inductance coil 18. The function of the coil 18 is to allow the passage of direct current, but to prevent the passage of alternating current of telephonic frequencies. In parallel with the battery 17 and inductance coil 18, the repeater coil primary 5 is connected through the condensers 19, 19 whose function is to prevent the passage of direct current through the winding 5. Artificial lines 20, 20, which may be of a well-known construction, are provided, said artificial lines having substantially the same impedance as the telephone line over the range of telephonic frequencies. Said artificial lines are provided in order that inductive effects from the output side of one repeater 11, impressed through the coil 5, shall not create any difference of potential between the conductors 8 and 9. This condition is necessary in order that the output side of one repeater shall not impress disturbances on the input side of the other repeater, and thus cause sustained interaction or "singing" between the repeaters 11, 11. The function of the filters 1^a, 1^a is to prevent currents other than those necessary for the telephonic transmission of intelligible speech from being transmitted from the telephone line to the input side of the repeaters 11, 11.

The repeater set shown in Fig. 11 is the same as that shown in Fig. 10 except as to the form of the wave-filter. In said Fig. 11, the wave-filter structure consists of a low frequency wave-filter 1^f and a high frequency wave-filter 1^s of the types shown in Figs. 6 and 7, respectively, connected in series. The advantage of this latter structure over that shown in Fig. 10 is that the low frequency wave-filter 1^f may be omitted from the circuit when conditions are such as not to require the protection of the repeater from low frequency disturbances.

It is well known that high frequency induction or inductive disturbances militate seriously against the satisfactory operation of telephone repeaters, particularly of the vacuum tube type, such as are shown in Figs. 10 and 11. It is also well known that low frequency disturbances, such as those due to superposed or composited telegraphic impulses are equally objectionable. My invention prevents either high frequency or low frequency disturbances from affecting the repeater by inserting wave-filters between the telephone lines and the repeaters, as shown, for example, in Figs. 10 and 11. In this particular case, said wave-filters are designed to transmit all frequencies lying within the limiting frequencies, say between 200 and 2200 cycles per second, necessary for intelligible telephonic transmission of

ech, while extinguishing currents of all quencies lying above 2200 and below 200 les per second.

A further advantage attending the em- yment of the wave filter with the repeater uits lies in the fact that the balancing ificial line need simulate the impedance racteristics of the telephone lines only r the limited range of frequencies neces- y for intelligible telephonic transmission peech, which permits of a more simple, ient, and economical artificial line.

The invention which consists in the co- rative combination of the wave filter of invention with a repeater, as illustrated Figs. 10 and 11, is not embodied in the ended claims, but forms the subject mat- of my co-pending application, Serial 101,845, filed June 5, 1916.

claim:—

An electric wave-filter consisting of a necting line of negligible attenuation taining lumped impedance in series with line and lumped impedance in shunt es the line, said impedances having pre- puted values dependent upon the upper ting frequency and the lower limiting uency of a range of frequencies it is de- d to transmit without attenuation, the es of said series and shunt impedances g so proportioned that the structure smits with practically negligible atten- on sinusoidal currents of all frequencies g between said two limiting frequencies, le attenuating and approximately ex- uishing currents neighboring frequen- lying outside of said limiting frequen-

An electric wave-filter consisting of a necting line of negligible attenuation posed of a plurality of sections, each sec- including a capacity element and an ctance element, one of said elements of section being in series with the line and other in shunt across the line, said ca- ty and inductance elements having pre- puted values dependent upon the upper ting frequency and the lower limiting uency of a range of frequencies it is de- l to transmit without attenuation, the es of said capacity and inductance ele- s being so proportioned that the struc- transmits with practically negligible uation sinusoidal currents of all fre- cies lying between said two limiting fre- cies, while attenuating and approxi- ly extinguishing currents of neighbor- requencies lying outside of said limiting uencies.

An electric wave-filter consisting of a ecting line of negligible attenuation containing lumped capacity in series with the line and lumped inductance in shunt across the line, said capacity and said inductance having precomputed values dependent upon the upper limiting frequency and the lower limiting frequency of a range of frequencies it is desired to transmit without attenuation, the values of said capacity and inductance being so proportioned that the structure transmits with practically negligible attenuation sinusoidal currents of all frequencies lying between said two limiting frequencies, while attenuating and approximately extinguishing currents of neighboring frequencies lying outside of said limiting frequencies.

4. An electric wave-filter consisting of a line composed of a plurality of sections, each section including a condenser and an inductance coil in series with the line, and an inductance coil in shunt across the line, said condensers and inductance coils having precomputed values dependent upon the upper limiting frequency and the lower limiting frequency of a range of frequencies it is desired to transmit without attenuation, the values of said condensers and said inductance coils being so proportioned that the structure transmits with practically negligible attenuation sinusoidal currents of all frequencies lying between said two limiting frequencies, while attenuating and approximately extinguishing currents of neighboring frequencies lying outside of said limiting frequencies.

5. An electric wave-filter consisting of a line composed of a plurality of sections, each section including a condenser in series with the line and an inductance coil and a condenser in parallel in shunt across the line, said condensers and inductance coils having precomputed values dependent upon the upper limiting frequency and the lower limiting frequency of a range of frequencies it is desired to transmit without attenuation, the values of said condensers and said coils being so proportioned that the structure transmits with practically negligible attenuation sinusoidal currents of all frequencies lying between said two limiting frequencies while attenuating and approximately extinguishing currents of neighboring frequencies lying outside of said limiting frequencies.

6. An electric wave-filter consisting of a line composed of a plurality of sections, each section having a condenser and an inductance coil in series with the line and a condenser and an inductance coil in parallel in shunt across the line, said condensers and inductance coils having precomputed values

dependent upon the upper limiting frequency and the lower limiting frequency of a range of frequencies it is desired to transmit without attenuation, the values of said condensers and said coils being so proportioned that the structure transmits with practically negligible attenuation sinusoidal currents of all frequencies lying between said two limiting frequencies while attenuating and approximately extinguishing neighboring frequencies lying outside of said limiting frequencies.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this ninth day of July 1915.

GEORGE A. CAMPBELL.

Witnesses:
GEORGE E. FOLK,
JOHN R. CARSON.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,227,113, granted May 22, 1917, upon the application of George A. Campbell, of Montclair, New Jersey, for an improvement in "Electric-Wave Filters," an error appears in the printed specification requiring correction as follows: Page 5, below line 25, for formula (II^c)—

$$\frac{C}{C_1}=\frac{1}{4}\left[\left(\frac{f}{f_1}\right)-1\right] \text{ read } \frac{C}{C_1}=\frac{1}{4}\left[\left(\frac{f}{f_1}\right)^2-1\right]$$

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of October, A. D., 1923.

[SEAL.]

WM. A. KINNAN,
Acting Commissioner of Patents.

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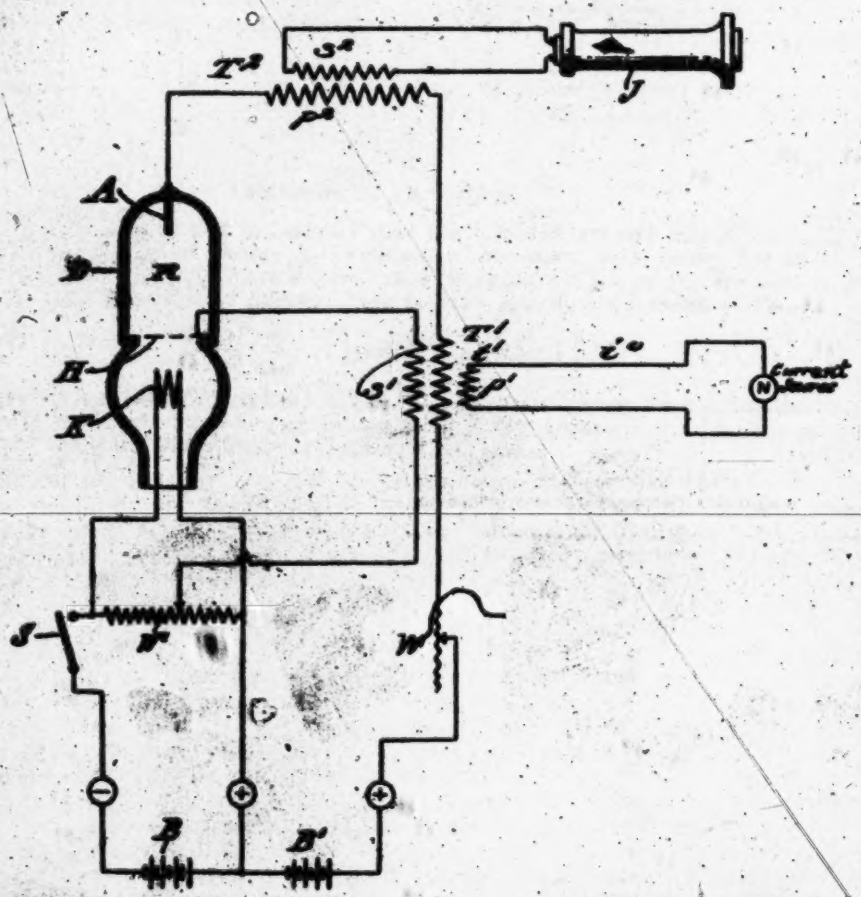
1483

E. REISZ.

PROCESS TO INCREASE THE SENSIBILITY OF RELAYS FOR ALTERNATING CURRENTS.

APPLICATION FILED APR. 9, 1913.

1,234,489. Patented July 24, 1917.



Witnesses:
Chas. S. Hoyer.

Inventor
Eugen Reisz
by
James L. Norris,
Attorney

UNITED STATES PATENT OFFICE.

EUGEN REISS, OF BERLIN-TREPTOW, GERMANY.

PROCESS TO INCREASE THE SENSIBILITY OF RELAYS FOR ALTERNATING CURRENTS.

1,234,489. Specification of Letters Patent. Patented July 24, 1917.

Application filed April 8, 1915. Serial No. 20,901.

To all whom it may concern:

Be it known that I, EUGEN REISS, a subject of the Emperor of Austria, residing at Berlin-Treptow, Germany, have invented certain new and useful Improvements in Processes to Increase the Sensibility of Relays for Alternating Currents, of which the following is a specification.

This invention relates to a method of increasing the sensibility of relays for alternating currents of a determined number of periods so that the currents reinforced react directly or inductively upon the relays. In this connection, it is presumed that alternating currents with simple curve form, for instance, sine currents, are to be reinforced. The method can only be employed when the relay has no mechanical inertia at all, as is the case, for instance, in gas discharging relays, as otherwise the self-oscillation of the apparatus would frustrate the effect just explained. In the drawing an apparatus is shown wherein the method may be effectively carried out, and therein an embodiment of the invention is represented in diagrammatic form.

Referring to the drawing, R is the relay consisting of a discharge tube D having a heated cathode K and an anode A between which an auxiliary electrode H of sieve or net form is arranged. A battery B provides the heating current for the cathode and a second battery B^1 the current for the tube. The auxiliary electrode is connected to the battery B by the adjustable resistance W^1. Two transformers T^2 and T^3 inductively connect the line N or other source of currents to be reinforced with the relay circuit and the latter circuit with the receiving instrument J respectively. The transformer T^2 consists of three windings s^2, s^1 and s^3; the winding s^2 is the primary of the transformer and is connected with the source N of the currents to be reinforced, for instance with the antenna; s^1 is the secondary winding cut into the circuit of the auxiliary electrode. The third winding s^3 of the transformer T^2 is arranged in the circuit which contains the anode A and the primary winding p^3 of the second transformer T^3. An adjustable resistance W is furthermore arranged in this circuit and prevents the generation of a continuous alternating current in said circuit and at the same time regulates the current flowing through the discharge tube. The terminals of the secondary winding s^3 of the transformer T^3 and the receiving instrument J, for instance a telephone, are connected. The source of the alternating current to be reinforced acts inductively through the auxiliary winding s^1, as above noted, upon the auxiliary electrode. The anode currents reinforcibly released in this manner flow through the winding p^1 and induce currents in the telephone and through the winding s^1 again influence the auxiliary electrode whereby a further increase of the anode current results. When the electric constants of coils T^2 and T^3 are selected in such manner that the currents reacting upon the relay coincide in their direction with the primary current, that is, when there is no shifting of phases present between the primary and secondary currents, then the amplitudes of the currents reinforced by the relay always become greater. The strength of these currents can be adjusted through the non-inductive resistance W cut into the anode circuit to the desired value. The resistance W also prevents the appearance of a continuous alternating current through the mutual induction of the windings s^1 and s^3.

The current s^2 coming from the line or other source of alternate current flows through the winding p^1 of the transformer T^2 and induces similar currents in the windings s^3 and s^1. The impulses in the circuit through s^1 are so timed that the current in s^1 is continually augmented, or the current induced in s^1 is in phase with the current induced in s^1 from p^1. The two circuits through the tube R are in resonance with each other and the capacity of the coils is relied upon to effect this tuning of the circuits.

What is claimed is:—

1. In a relay system comprising a relay without inertia, a line circuit, an actuating circuit for said relay containing the currents to be reinforced and a local relay circuit containing the reinforced currents, the two last-named circuits being adjusted to resonance, each of the circuits being provided with a winding and all the windings acting inductively on the other windings.

2. In a relay system comprising a relay without inertia, a line circuit, an actuating circuit for said relay containing the currents to be reinforced and a relay circuit containing the reinforced currents, means to establish resonance between the two last

named circuits, a transformer comprising a winding embodied in the relay circuit, a second winding embodied in the actuation circuit and a third winding embodied in the line circuit, all windings being capable of exercising an inductive action on the others, and a second transformer comprising a winding embodied in the relay circuit and a second winding connected with a receiving instrument.

3. In a relay system comprising a relay without inertia, a line circuit, an actuating circuit for said relay, containing the currents to be reinforced and a relay circuit containing the reinforced currents, means to establish resonance between the two last named circuits, a transformer comprising a winding embodied in the actuating circuit of the relay and a second winding embodied in the relay circuit, both windings being capable of acting inductively on each other, the self-induction of both being so established that the currents induced in the first named winding by the other winding have a phase displacement of 90° relatively to the inducing currents.

4. In a relay system comprising a gas discharge relay having a cathode, an anode and an auxiliary electrode, a line circuit carrying alternating currents of simple curve form, an actuating circuit for the relay connected with the auxiliary electrode of the same, and a relay circuit connected with the anode and cathode of the relay, means to establish resonance between the two last named circuits, a transformer comprising a winding embodied in the line circuit, a second winding embodied in the circuit of the auxiliary electrode, and a third winding embodied in the circuit of the anode, all the windings being arranged to act inductively on each other, the self-induction of the second and third of these windings being so established that the currents induced in the second winding by the current in the third winding have a phase displacement of 90° relatively to the inducing currents and a second transformer comprising a winding embodied in the anode circuit and a winding connected with a receiving instrument.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EUGEN REISZ.

Witnesses:
SIEGMUND STRAUSSE,
LUDWIG ZWEIN.

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PAGE

1486

E. H. COLPITTS.

SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE.

APPLICATION FILED APR. 9, 1912.

Reissued Oct. 23, 1917. 14,380.

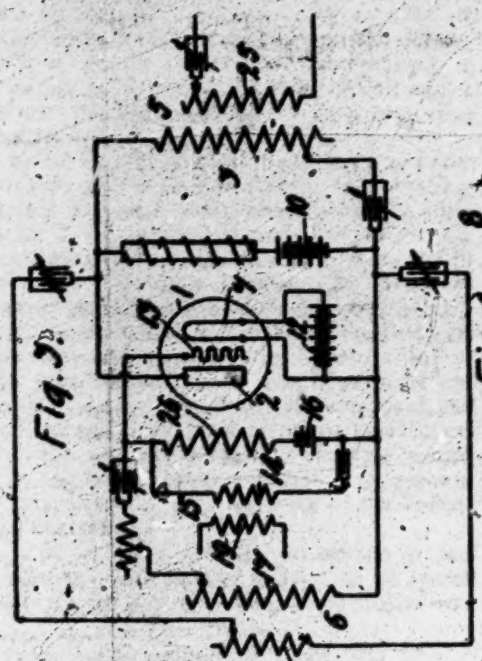


Fig. 3.

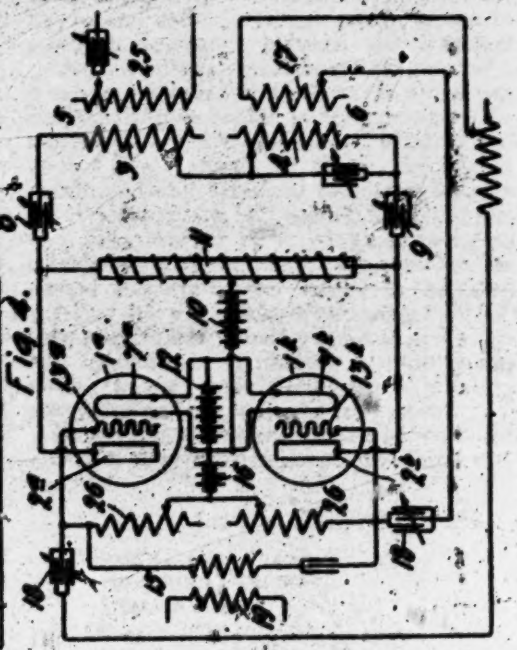


Fig. 4.

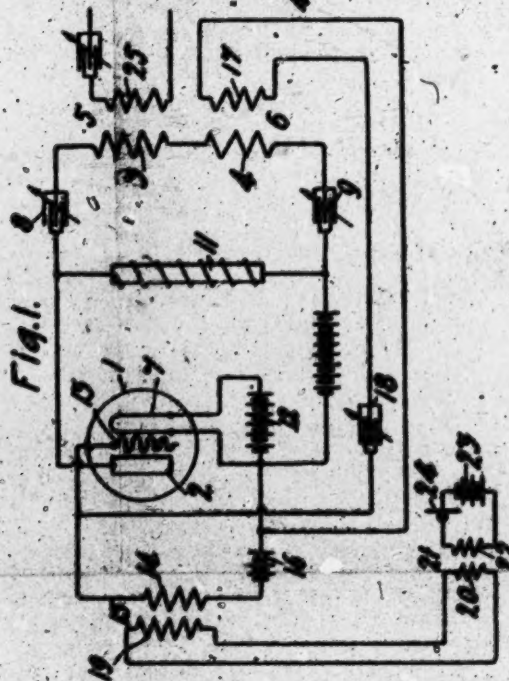


Fig. 1.

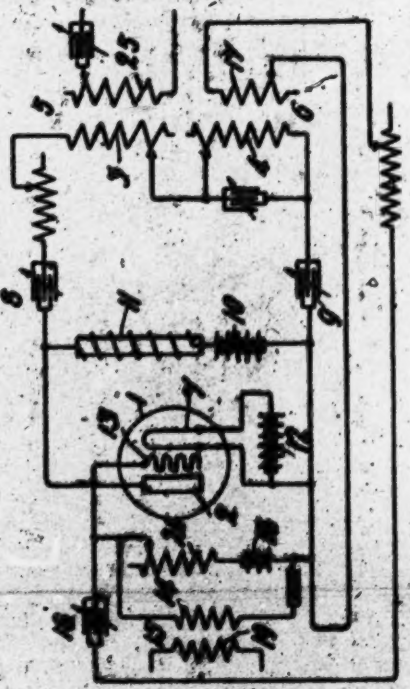


Fig. 2.

Inventor:
Edwin H. Colpitts.
by J. B. Roberts
Att'y.

UNITED STATES PATENT OFFICE.

EDWIN H. COLPITTS, OF EAST ORANGE, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AMERICAN TELEPHONE & TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE.

1a,280. Specification of Reissued Letters Patent. Reissued Oct. 23, 1917.

Original No. 1,127,864, dated April 27, 1915, Serial No. 823,215, filed May 13, 1914. Application for reissue filed April 9, 1917. Serial No. 160,871.

To all whom it may concern:

Be it known that I, EDWIN H. COLPITTS, a subject of the King of Great Britain, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Systems for the Transmission of Intelligence.

This invention relates to systems for the transmission of intelligence, in which the amplitudes of successive electrical oscillations of high frequency are varied in accordance with the lower frequency forms of the messages delivered.

Its object is to simplify the mechanism and to strengthen the effectiveness of the apparatus required for the production of the modulated oscillations.

To these ends the invention embodies a repeater which serves not only as a generator of high frequency oscillations, but also as a means for modulating the oscillations in accordance with the low frequency signaling impulses to be transmitted.

The invention is adapted for embodiment in systems of wireless telegraphy and telephony in so-called high frequency wired systems, and in general wherever a receiving device is rendered sensitive to signaling impulses or waves of low frequencies by means of sustained electric or electromagnetic waves of high frequency transmitted from the sending station.

The single device used to perform the two functions referred to may be a repeater, preferably a repeater of the audion type, wherein the output circuit is connected with the input circuit, this arrangement, with proper adjustment of devices in the circuit, resulting in the production of sustained high frequency oscillations. By varying the potential in the input circuit, as for example by connecting a transmitter or other device for sending a message in circuit with one of the electrodes, say the grid, of the audion, the sustained oscillations, it has been found, are then modulated in accordance with the message to be sent. The message may be received or recorded in any desired manner at the distant station.

Several embodiments of the invention will be set forth in the following detail description taken in connection with the accompanying drawings, wherein—

Figure 1 illustrates a system of circuits embodying the invention; and Figs. 2, 3 and 4 are modified circuits therefor.

Like parts are designated alike in the several figures.

Referring first to Fig. 1, an audion 1, the elements of which are inclosed in an evacuated vessel, as usual, is arranged with its output anode or plate 2 connected through the primary windings 3 and 4 of repeating coils 5 and 6 to the negative terminal of the heated filament or cathode 7 of the audion. Included in this output circuit may be located a battery 10 and, as required, adjustable devices such as the condensers 8 and 9. Bridged across the circuit, to feed battery current to the plate 2, is a coil of high impedance 11. The filament 7 is heated by current from the battery 12. The input electrode or grid 13 of the audion is connected through the secondary winding 14 of a repeating coil 15 to the negative terminal of the filament 7, and included in this, the input circuit, there may be located a battery 16. The secondary winding 17 of the repeating coil 6 is connected through an adjustable condenser 18 with the input circuit, one wire leading to the grid 13 and the other wire to the negative terminal of the filament 7.

The primary winding 19 of the repeating coil 15 may be connected in circuit with the secondary winding 20 of another repeating coil 21, the primary winding 22 of which is connected in circuit with a battery 23 and a sending device, which, as shown, may be a telephone transmitter 24. The repeating coil 5 has a secondary winding 25, the terminals of which lead to the antenna of a wireless system or to the line of a wire circuit, according to the particular use to which the apparatus is put.

The operation of the system illustrated in Fig. 1 is as follows: The audion 1 is rendered active by the heated filament 7, which emits a stream of negative ions across the space intervening between it and the positively charged plate 2. This stream passes through the interspaces of the grid. The battery 10, acting through the resistance of the coil 11, tends to maintain a steady flow of current in the output circuit, including the ionized space between the plate 2 and the filament 7. The flow of current across the ionized space, however, is not steady but is caused to

fluctuate at a very high frequency, by reason of the interaction between the input and output circuits through the repeating coil 6. The frequency of the sustained oscillations produced by this arrangement may be varied by adjusting the capacities of the various condensers in the circuit. The high frequency currents in the output circuit are transmitted by the repeating coil 5 into the line or antenna to which the secondary winding 25 may be connected.

By means of the telephone transmitter 24, the amplitude of the sustained oscillations is modified or modulated in accordance with sound waves which are of a lower order of frequency. This may be explained as follows: At the normal potential of the battery 16 impressed on the grid 13, the sustained oscillations are produced at a constant amplitude. At a higher potential, due to a positive impulse from the winding 14, the current in the output circuit is increased, and the amplitude of the high frequency oscillations is greater. Conversely, at a lower potential, due to a negative impulse, the oscillations become lesser in amplitude than normal. Thus each pulsation of potential, caused by speaking into the transmitter 24, is effective in producing a corresponding variation in the amplitude of oscillations of current, and therefore of energy in the output circuit and likewise in the line or antenna.

In Fig. 2 is shown an arrangement differing from that of Fig. 1 in that the battery 10 thereof, corresponding to the like numbered battery in Fig. 1, is connected in series with the high impedance coil 11 in bridge of the output circuit. The arrangement is also different in that the battery 16 is included in a bridge of the input circuit in series with an adjustable resistance 26.

In Fig. 3 is illustrated a modified circuit in which the battery 10 is included in series with the high impedance coil 11 as it is in Fig. 2, but primary windings 3 and 4 of the repeating coils 5 and 6 are connected in parallel with relation to each other instead of in series as in Figs. 1 and 2.

In Fig. 4 an arrangement is shown in which two audions 1^a and 1^b are used. Here the battery 10 is connected to a central point in the winding of the high impedance coil 11, the outer terminals of which are connected to the two plates 2^a and 2^b, respectively, of the two audions. Battery 16 is likewise connected to a midpoint of an adjustable resistance 26, the outer terminals of which are connected to the two grids 13^a and 13^b. In the system of Fig. 4, therefore, the battery 10 tends to supply a steady flow of current through both audions from the plates 2^a and 2^b to the two filaments 7^a and 7^b, respectively. The battery 12 supplies current to both of the filaments 7^a and 7^b. The operation is such that the impulses from the repeating coils 6 and 15 produce at any instant of time opposite potential variations on the grids 13^a and 13^b, and these opposite potential variations produce an effect which is cumulative in the output circuit to which the plates 2^a and 2^b are connected.

What is claimed is:

1. The combination with a vacuum tube having a filament, a plate and a grid, an input circuit connected with the grid and an output circuit connected with the plate; of means for impressing sustained high frequency oscillations on said input circuit; and a source of low frequency potential variations connected to said input circuit, said output circuit comprising means for supplying modulated high frequency oscillations.

2. The combination with a vacuum tube having a filament, a plate and a grid, an input circuit connected with the grid and an output circuit connected with the plate; of means for impressing sustained high frequency oscillations on said input circuit, and signaling means associated with said tube, said output circuit comprising means for supplying high frequency oscillations modulated in accordance with the signal.

3. The combination with a generator of high frequency oscillations, comprising a repeater of the feed-back type and an input and an output circuit connected to each other to produce sustained high-frequency oscillations, of means for modulating said high frequency oscillations in accordance with low frequency signaling impulses.

4. The combination with a generator of high frequency oscillations, comprising a vacuum tube repeater of the audion type and input and an output circuit therefor arranged to react upon each other to produce sustained high-frequency oscillations, of means for modulating said high frequency oscillations in accordance with low frequency signaling impulses, and a transmission circuit for receiving the modulated high frequency oscillations.

5. The combination with a generator of high frequency oscillations, comprising a repeater having an input and an output circuit connected with each other for producing sustained high-frequency oscillations, of a source of low frequency potential variations, and circuit connections by which said low frequency potential variations vary the amplitude of said high frequency oscillations.

6. The combination of a vacuum tube repeater of the audion type adapted to generate sustained high frequency oscillations, with means for modulating said oscillations in accordance with a telephone signal to be transmitted, and means for transmitting the modulated high frequency oscillations so produced.

7. In a system for signaling by high frequency oscillations, a thermionic device of the audion type for modulating high frequency oscillations in accordance with low frequency signals, said device having an input and an output circuit, said input circuit comprising a heated filament and a controlling electrode, means for generating low frequency signals, and means for impressing said low frequency signals upon the input circuit of said device.

8. In a system for signaling by high frequency oscillations, a thermionic device for modulating said high frequency oscillations in accordance with low frequency signals, said device comprising an evacuated vessel containing a filament, an auxiliary electrode and a plate element, and means for changing the potential of the auxiliary electrode with respect to the filament in accordance with low frequency signals to be transmitted.

9. In a system for signaling by high frequency oscillations, a thermionic device for modulating said high frequency oscillations in accordance with low frequency signals, said device comprising an evacuated vessel containing a filament, an auxiliary electrode and a plate element, means for generating low frequency signals, and means for impressing said signals between the filament and the auxiliary electrode.

10. In a system for signaling by high frequency oscillations, a thermionic device for modulating said high frequency oscillations in accordance with low frequency signals, said device comprising an evacuated vessel containing a filament, a grid and a plate element, means for generating low frequency signals, and means for simultaneously impressing on said grid the high frequency oscillations and the low frequency signaling impulses.

11. A signaling system comprising an audion having filament, grid and plate electrodes, means for supplying high frequency oscillations to said audion, signaling means associated with said audion, and a circuit connected to said plate and said filament electrodes for leading off from said audion high frequency oscillations modulated in accordance with said signal.

12. A signaling system comprising an audion having filament, grid and plate electrodes, means for supplying high frequency oscillations, means for supplying signaling oscillations, means comprising said audion for modulating said high frequency oscillations in accordance with said signaling oscillations, and a circuit connected to said filament and plate electrodes for leading off the modulated oscillations from said audion.

13. The combination with a generator of high frequency current, comprising a repeater and an input and an output circuit therefor united with each other, said repeater having an electrode located in said input circuit; of a transmission line united with said output circuit, and a source of low frequency potential variations connected to said electrode.

14. The combination with an audion having a filament, a plate and a grid, an input circuit connected with the grid and an output circuit connected with the plate; of an inductive connection between said output and said input circuits adapted to the production by said audion of sustained high frequency oscillations, and a sending device, adapted for producing signaling impulses of low frequencies, connected with said input circuit.

15. The combination with a generator of high frequency current, comprising a repeater, an input and an output circuit therefor and a connection between said circuits; of a transmission line united with said output circuit, and a sending device adapted for producing signaling impulses of low frequencies, connected with said input circuit.

16. The combination with a generator of high frequency current, comprising an evacuated vessel, means for producing a state of ionization in said vessel, and an input and an output circuit interconnected to react upon each other; of means connected with said input circuit for producing low frequency potential variations in said input circuit.

17. The combination with a generator of high frequency current, comprising an evacuated vessel, means for producing a state of ionization in said vessel, and an input and an output circuit inductively connected with each other; of a source of low frequency potential variations connected with said input circuit for controlling the amplitude of the high frequency currents developed by said generator.

18. The combination with a generator of high frequency current, comprising an evacuated vessel, means for producing a state of ionization in said vessel, and an input and an output circuit connected with each other; of means included in said circuits for adjusting the frequency of said current; and a source of low frequency potential variations connected with said input circuit for controlling the amplitude of the high frequency currents developed by said generator.

19. In apparatus of the kind described, the combination of an evacuated vessel and means, including a cathode, for producing a state of ionization in said vessel; of an input anode and an output anode in said vessel; an output circuit connected to said output anode and including an adjustable condenser and a source of continuous cur-

rent, an input circuit connected to said input anode and inductively connected to said output circuit, and means connected with said input circuit for producing low frequency potential variations in said input circuit.

20. The combination with an audion having an input circuit and an output circuit inductively connected with each other; of means connected with said input circuit for producing low frequency potential variations in said input circuit.

In witness whereof, I hereunto subscribe my name this 12th day of March, 1917.

EDWIN H. COLPITTS.

1491

H. W. NICHOLS.

LOW FREQUENCY SIGNAL REPEATER.

APPLICATION FILED SEPT. 24, 1913.

1,257,381.

Patented Feb. 26, 1918.

2 SHEETS—SHEET 1.

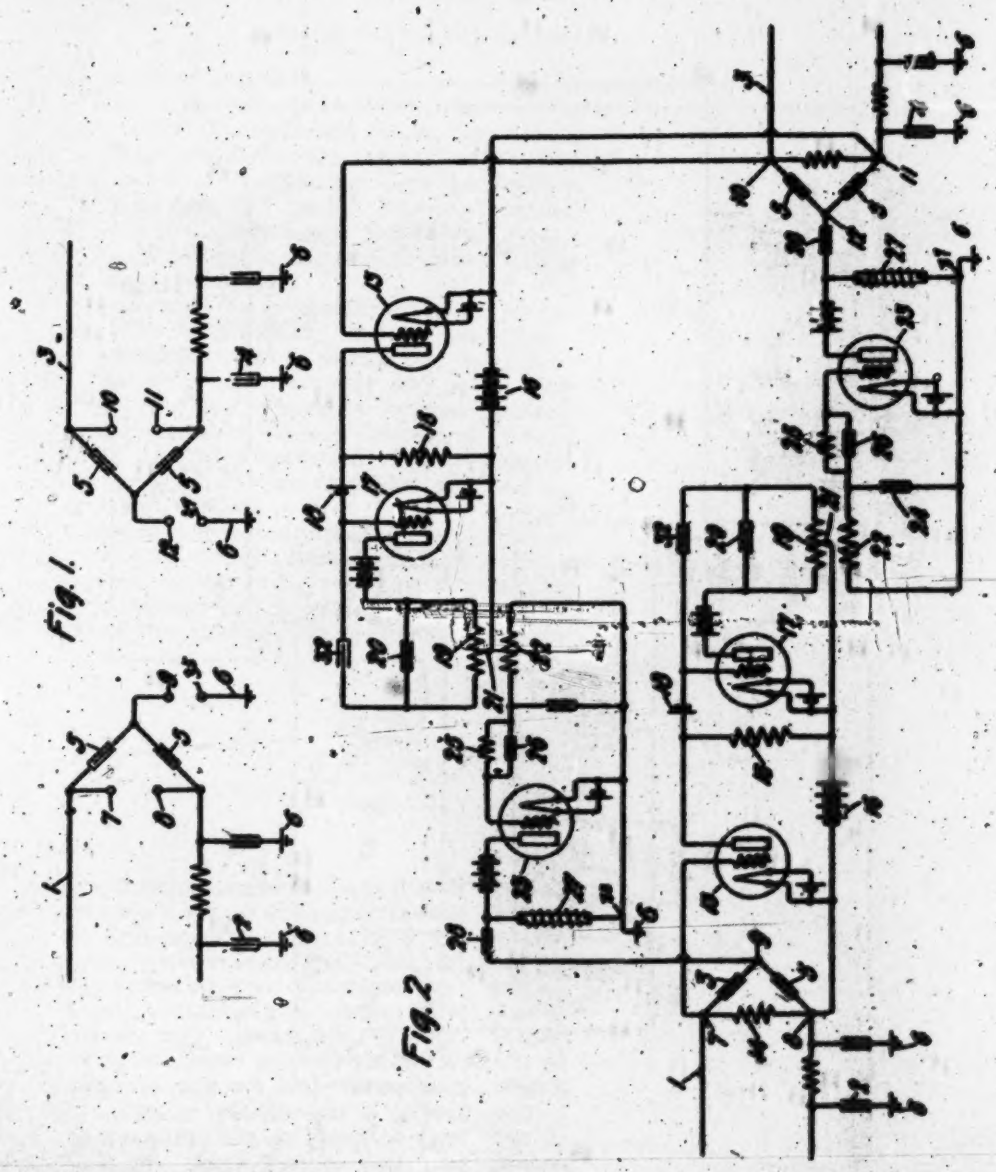


Fig. 1.

Fig. 2.

Witnesses:
O. E. Rasmussen
John Waldheim

Inventor:
Harold W. Nichols.
by A. C. Monnel. Atty

1492

H. W. NICHOLS.

LOW FREQUENCY SIGNAL REPEATER.

APPLICATION FILED SEPT. 24, 1915.

1,257,381.

Patented Feb. 26, 1918.

2 SHEETS—SHEET 2.

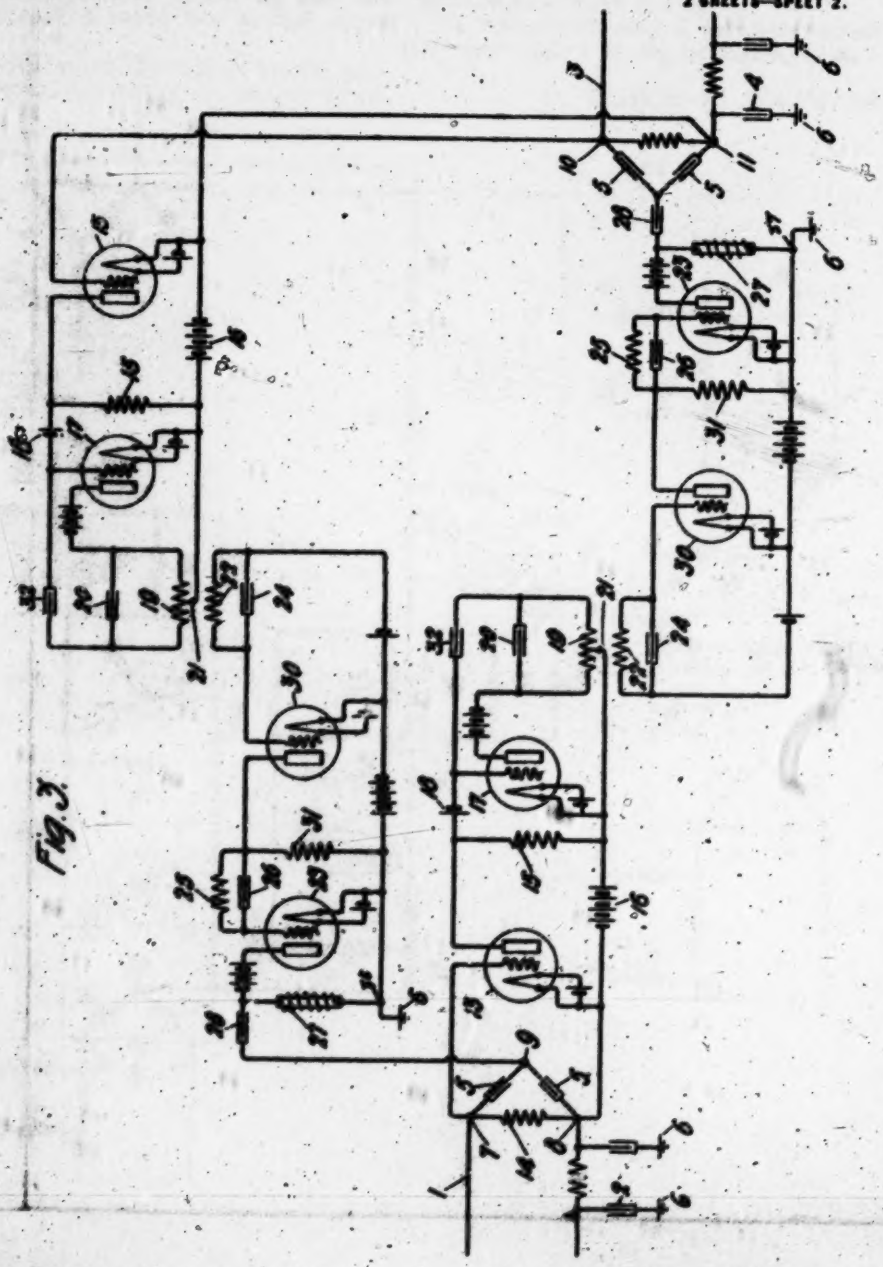


Fig. 3.

Witnesses:

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Inventor:

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UNITED STATES PATENT OFFICE.

HAROLD W. NICHOLS, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

LOW-FREQUENCY-SIGNAL REPEATER.

1,257,381. Specification of Letters Patent. Patented Feb. 26, 1918.

Application filed September 24, 1915. Serial No. 52,502.

To all whom it may concern:

Be it known that I, HAROLD WILLIAM NICHOLS, a citizen of the United States, residing at Maplewood, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Low-Frequency-Signal Repeaters, of which the following is a full, clear, concise, and exact description.

This invention relates to a method of and apparatus for the repeating of messages from one submarine cable or similar line to another. Its object is to amplify and repeat in one line low frequency currents originating in another without destroying the property of duplex operation of either line, and to perform this operation efficiently and with fidelity.

These objects are accomplished by employing auxiliary circuits between the two lines in question, supplying these circuits with alternating current, varying the characteristics of the currents in these circuits by means of the incoming signal, and translating these variations to the forms of signals to be transmitted to the outgoing lines. These operations are desirable for reasons which will appear in the following discussion of the problems involved in the efficient repetition of signals between two duplex cables, telegraph lines or other circuits carrying low frequency signaling currents.

It has been found that repeaters of the mechanical type, for example, those in which an electromagnetic receiving device actuates a microphone, are not suitable for use in connection with low frequency signaling circuits. On the other hand, the thermionic repeater of the audion type, by reason of its high sensitiveness and its freedom from distorting effects, is especially fitted for this kind of work. This repeater consists of an electron-emitting cathode, an anode, and an auxiliary electrode, all inclosed in an evacuated vessel.

An important feature of this device in connection with this problem is that its input circuit and its output circuit necessarily have one point in common, since the repeater has but three terminals. This fact introduces into the problem of repeating from one duplex cable to another some difficulties which are overcome in this invention, and which will be explained in connection with the drawings.

In these drawings, Figure 1 shows the circuit arrangements of two duplex cables terminating at a repeater station; Fig. 2 shows a method of repeating from one of these cables to the other in accordance with this invention; and Fig. 3 shows a modified form of the invention in which greater amplification of signals is secured. In all of these figures, corresponding parts are denoted by like numerals.

Referring to Fig. 1, 1 and 3 are cable conductors and 2 and 4 their balancing artificial cables introduced, as usual, to permit duplex operation in connection with the condensers 5. 6 represents a ground connection.

In receiving a signal over cable 1 the receiving instrument is connected to the receiving terminals 7—8, and in sending through this cable an electromotive force is applied between the transmitting terminals 35—9. When the artificial line is exactly like the corresponding actual line, and when the condensers 5 are equal, this sending electromotive force produces no difference of potential between the terminals 7—8, and, consequently, the receiving instrument is not affected in sending from the station at which it is located. Duplex operation is therefore possible over these two cables, and its success depends upon the accurate simulation of the actual line by its artificial line.

Now, if it is desired to relay signals from cable 1 to cable 3, it will be necessary to connect the receiving terminals 7—8 of cable 1, through an amplifier, with the transmitting terminals 12—37, of cable 3, and similarly terminals 10—11 with terminals 35—9, and, as stated before, it is desirable to use the thermionic amplifier for this purpose. That amplifier, however, has a conducting connection between input and output circuits, and an examination of Fig. 1 will show that no matter how such an amplifier is connected from the receiving terminals of one cable to the transmitting terminals of the other, it will short-circuit one of the lines and destroy the property of duplex operation.

There must be no conducting path, except for the earth, from one cable to the other

if duplex operation is to be maintained. To eliminate such a conducting connection, an inductive one might be substituted, for instance by connecting the receiving terminals of one cable to the primary winding of a transformer, the secondary winding of which might then be connected, through an amplifier, to the transmitting terminals of the other cable.

This is the invention of another and is, moreover, open to the serious objection that the transformation of currents, of the wave forms and frequencies used in telegraphy, is not efficient and that it requires specially designed and expensive transformers. This invention eliminates the necessity for inefficiently transforming currents of the low fundamental frequency and complicated wave form here encountered, and substitutes therefor efficient transformation of sinusoidal currents of a single relatively high frequency in a manner more completely described in connection with Fig. 2 which represents a preferred form of the invention, and also in connection with Fig. 3 in which an additional amplifier is used to secure greater amplification.

Referring to Fig. 2, numerals 35, 37 and 1 to 12 inclusive, represent two duplex cable terminals, as explained in connection with Fig. 1. 12 is a thermionic amplifier of the audion type whose function is to amplify the potential difference over the resistance 14 inserted between the receiving terminals 7—8 of the first cable. Its action is as follows: When a potential difference is established over the input terminals of 12, the effect is to change the current set up by the battery 16 in the output circuit of the amplifier, which includes resistance 15. The change in voltage drop over 15, due to that input potential difference, is much greater than the latter. Another function of the amplifier 12 is to prevent the reaction upon the incoming cable of the current in the apparatus next to be described. This effect is secured because the thermionic amplifier is a unilateral device and permits the transfer of power in but one direction through it.

17 is another amplifier adapted to act as an oscillation generator. Any amplifier, when arranged so that power may be fed back from its output circuit to its input circuit, for example, by inductively connecting them circuits, will oscillate freely if the amplifying power is sufficiently large. The power represented by this free oscillation is drawn from the battery in the output circuit. In the oscillator of the figure a tuned circuit, comprising coil 19 and condenser 20, is included in the output circuit, while the input circuit includes half the coil 19, due to the fact that the filament or cathode of the repeater is connected to coil 19 at the point 21. Since the two halves of the coil 19 are related by mutual inductance, the two circuits are inductively connected and the device acts as an alternating current generator of oscillations whose frequency is determined by the tuned circuit 19—20.

The input circuit of this oscillating amplifier is also connected across resistance 15, by which connection the amplified signal voltage is impressed upon the input circuit of 17, preferably through the battery 18, which is used to maintain the potential of the grid at a suitable value with respect to that of the filament. The effect of impressing this variable signal voltage upon the amplifier 17 is to change its amplifying power and, therefore, to vary the amplitude of the alternating current in its output circuit in accordance with the signal received over the cable 1. This method of modulating the amplitude of an alternating current is not the invention of this applicant and is not claimed in this application.

The coil 19 is inductively coupled to coil 22 of the tuned circuit 22—24, and since now a pure alternating current of relatively high frequency is in question, the transformation by the transformer 19—22 is efficient in contrast to the case in which the signal waves themselves must be transformed.

It is now necessary to rectify this modulated current so that the effect of the high frequency alternating current shall be eliminated. This is done by the thermionic element 23 in whose input circuit are inserted condenser 26 and resistance 25. These assist in the rectification (which takes place in any thermionic element of the audion type when its output terminals are closed through a low impedance) as follows: Suppose that an impulse of positive potential with respect to the filament is impressed upon the grid circuit so that the grid becomes positively charged. This charge will now be rapidly neutralized by the flow of electrons from the heated filament to the grid. If now this positive impulse is followed by a negative impulse, the negative charge remaining upon the grid will be still further increased, and, therefore, the space current in the audion, whose magnitude is governed by the charge upon the grid, will be decreased more than would be the case if the negative charge first mentioned had been free to leak away. It is prevented from so doing by the condenser 26. However, it is not desirable to retain this negative charge upon the grid indefinitely, and to prevent this the resistance 25 is shunted about the condenser. This resistance is so large that the leak of current through it in a time comparable with the period of the high-frequency oscillation is small, but this leakage path is made of sufficiently low resistance to permit the complete discharge of the grid in the intervening elapsing between sig-

nals. The effect of this combination of resistance and capacity is, therefore, to increase the rectifying effect of the thermionic element. As in the operation of any rectifier, it responds only to the envelop of the high frequency oscillations, that is, it produces in its output circuit a direct current upon which is superposed a current of the wave form of the signal received from the first cable. The high inductance choke coil 27 permits the free passage of the necessary direct current in the output circuit of 23 while offering a high impedance to the signal currents superposed upon it, which latter are therefore impressed upon the transmitting terminals 12—37 of the outgoing cable, preferably through condenser 28. A condenser 29 is preferably added in the output circuit of amplifier 17 to prevent the short-circuiting of resistance 15. A similar system of circuits leads in the opposite direction, that is, from the receiving terminals 10—11 to the transmitting terminals 35—9 of the first cable.

Fig. 3 represents an arrangement similar to Fig. 2 except that an additional amplifier is added to still further increase the energy of the repeated signals impressed upon the second line. In this arrangement the tuned circuit 22, 24 instead of being directly connected to the rectifying element 23, is now connected to the input electrodes of the thermionic amplifier 30. The output circuit of this amplifier is completed through the resistance 31 and contains an energizing battery as shown. The rectifying element 23 is then connected across the terminals of resistance 31. This modifies the operation of the device only in so far as it increases the voltage supplied to the rectifier, and consequently increases the value of the rectified current. An advantage secured by the use of this amplifier, in addition to the greater power obtained, is that the thermionic element, when acting as a rectifier, is more efficient when the voltage impressed across its input terminals is large. In all other respects this arrangement is similar to that shown in Fig. 2.

Although this invention has been shown as applied to the amplification of signals from one duplex cable to another, it is obvious that its advantageous use will not be restricted to this type of apparatus. Its use may be desirable in any system requiring the transforming or repeating of low frequency signals.

What is claimed is:

1. In combination with two duplex lines having receiving and transmitting terminals adapted for electrical signaling with low frequency currents, a device for relaying signals from one to the other of said lines, a similar device for relaying signals in the opposite direction, means for providing for non-interference between said devices, each of said devices consisting of a circuit, means for producing therein electrical oscillations capable of efficient transformation, means for varying the character of said oscillations in accordance with a signal received from one of said lines, said varying means comprising a resistance shunted across the receiving terminals of said line, an amplifier having an output circuit, and a transformer whereby the effect of said variable oscillations is communicated to said amplifier and thereby augmented, a detector connected with said output circuit, and means for impressing upon the other of said lines the detected current.

2. In telegraphy, two duplex lines adapted to transmit low frequency signals, each line having separate receiving and transmitting terminals, the combination with the transmitting terminals of one line and the receiving terminals of the second line, of a circuit containing a modulator wherein is developed an alternating current, of a thermionic amplifier interlinked with said circuit and with the receiving terminals of the first of said lines whereby the amplitude of the alternating current is varied in accordance with the electrical signals in said line, of a transformer for inductively communicating the oscillations in said current to a second circuit, of a thermionic detector whose input electrodes are connected to said second circuit, the transmitting terminals of said line being so connected to the output circuit of said detector as to be influenced by the rectified currents appearing in said output circuit.

3. In telegraphy, two duplex lines adapted to transmit low-frequency signals, the combination with the receiving terminals of one of said lines and the transmitting terminals of the second of said lines, of a generator of high frequency oscillations, means for directly coupling said generator to said receiving terminals whereby the high frequency oscillations are varied in accordance with the wave form of the signals received over one of said lines, a detector, and a transformer whereby the effect of said modulated current is communicated to said detector, and means associated with the output circuit of said detector for impressing the detected current upon said transmitting terminals.

4. In telegraphy, two lines adapted to transmit low frequency signals, each line having separate receiving and transmitting terminals, the combination with the transmitting terminals of one line, and the receiving terminals of the second line, of a resistance shunted across said receiving terminals, of an oscillation generator wherein is developed an alternating current, of a thermionic amplifier having an input cir-

cuit and an output circuit, said resistance serving as a means for impressing the electrical signals in said line upon said input circuit, of means for directly impressing the amplified signals in said output circuit upon said oscillation generator, whereby the amplitude of the alternating current is varied in accordance with said signals, of a thermionic detector having an input circuit and an output circuit, of a transformer for inductively communicating the oscillations in said current to the input circuit of said detector, the transmitting terminals of said line being so connected to the output circuit of said detector as to be influenced by the detected current appearing in said output circuit.

5. In telegraphy, a duplex line, a vacuum tube repeater containing a cathode and an auxiliary electrode, said line terminating in said electrodes and auxiliary apparatus associated with said line and tube for the two-way transmission of signals.

6. In telegraphy, a duplex line, two shunt paths across said line, one of said paths comprising a resistance, the other being a capacity path, a vacuum tube repeater, means for impressing the drop of potential across said resistance upon the input electrodes of said repeater, and means comprising a second repeater connected to an intermediate point of said capacity path for impressing signaling currents upon said line without effectively impressing them upon said first repeater.

7. In telegraphy, a duplex line, two shunt paths across said line, one of said paths comprising a resistance, the other being a capacity path, a vacuum tube repeater having its input electrodes shunted across said resistance, and means comprising a second vacuum tube repeater connected to the mid-point of said capacity path for impressing signaling currents upon said line without impressing them upon said first repeater.

In witness whereof, I hereunto subscribe my name this 28rd day of September, A. D., 1915.

HAROLD W. NICHOLS.

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B. W. KENDALL.

HIGH FREQUENCY SIGNALING.

APPLICATION FILED NOV. 29, 1915.

1,330,471. Patented Feb. 10, 1920.

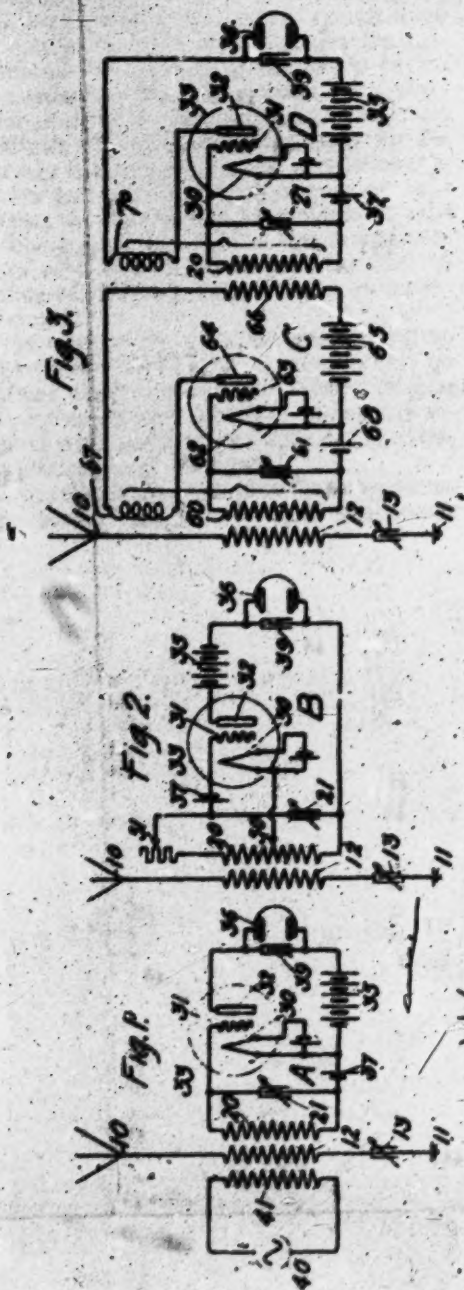


Fig. 3.

Fig. 2.

Fig. 1.

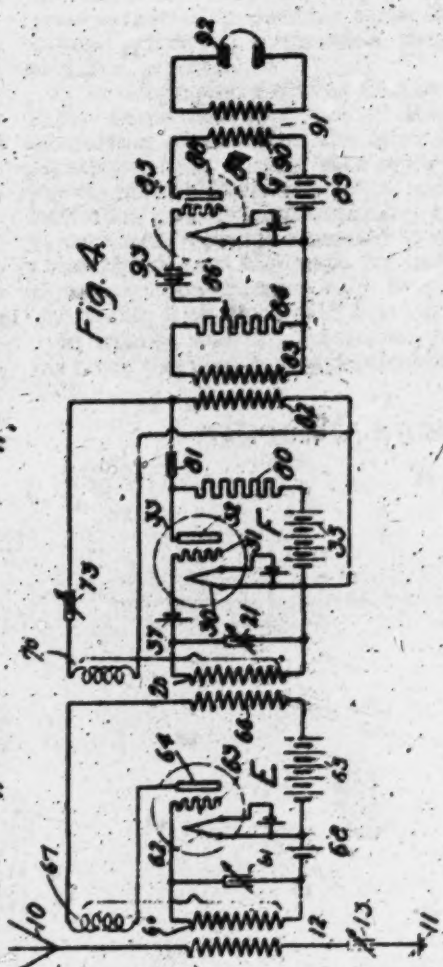


Fig. 4.

Inventor
Burton W. Kendall
by A. C. Shaw Atty.

UNITED STATES PATENT OFFICE.

BURTON W. KENDALL, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

HIGH-FREQUENCY SIGNALING.

1,330,171. Specification of Letters Patent. Patented Feb. 10, 1920.

Application filed November 29, 1915. Serial No. 64,093.

To all whom it may concern:

Be it known that I, BURTON W. KENDALL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in High-Frequency Signaling, of which the following is a full, clear, concise, and exact description.

This invention relates to a method and apparatus for receiving high frequency oscillations which have been modulated in accordance with low frequency signals, such as speech.

In wireless signaling, the extraordinary weakness of the received signals makes it highly desirable to use means for intensifying the effect produced on the translating device. In the case of wireless telegraphy, this is a comparatively simple matter, for the chief requirement is to obtain an indication, with small regard for the distortion produced. In the case of wireless telephony, however, where the high frequency carrier waves are modulated in accordance with the speech signals to be sent, the problem is much more difficult, for the intelligibility of the translated signals depends on the faithful reproduction of the modulations of the carrier waves. This means that the distortion must be kept to a minimum.

The method of intensification which is here shown depends upon the local generation of oscillations at the receiving station, which oscillations are combined with the received oscillations to produce a much stronger effect in the indicator than would be produced by the received oscillations alone.

A method of wireless telegraph reception, which has now become well known in the art, is the heterodyne method, which consists essentially in receiving the weak signal oscillations and combining them with locally generated oscillations of a slightly different frequency. This results in the production of beats which are of a frequency equal to the difference between the frequency of the received and that of the locally generated oscillations. This difference is adjusted to be within the audible limit, and a note corresponding to this beat frequency is heard in the receiver. However, the pitch of this note depends in no way on the form of the transmitted wave, but only on the difference in frequency between the transmitted high frequency oscillations and the locally generated oscillations.

While this method is well adapted for telegraphic messages, it cannot, of course, be used for telephonic signaling. It has been found, however, that by generating local oscillations of a frequency identical to the carrier frequency and combining them with the received high frequency oscillations, one can receive oscillations which have been modulated in accordance with speech, and that the resulting translated signals in the receiver are highly intensified. It is obvious that the resulting translated signals in the receiver will also be intensified in case the modulation is not in accordance with speech but in accordance with a musical note, for instance. The invention is of particular advantage in any case where a faithful reproduction of the signal is desired.

The invention will be better understood by reference to the following specification and accompanying drawings, in which Figure 1 shows a receiving station embodying this invention; Fig. 2 shows a modification in which the receiving circuit itself generates the local oscillations; Fig. 3 shows a circuit in which the received oscillations are first amplified and then combined with local oscillations of carrier frequency; and Fig. 4 is a modification of Fig. 3.

Referring to the drawings, in each of the figures 10 represents a receiving antenna of the usual type employed in wireless signaling. This antenna is connected to ground at 11, and between the antenna and the ground connection are placed a suitable variable inductance 12 and condenser 13, by means of which the receiving system may be tuned to any desired frequency, preferably the frequency of the signals which are to be received. This condenser may be shunted by a very high non-inductive resistance or may be omitted entirely.

Inductively associated with the antenna shown in Fig. 1 is a tuned circuit consisting of the inductance 20 and the condenser 21. Connected in shunt to the condenser 21 is a detector, and there is, in this case shown a detector of the audion type which comprises the usual heated filament 30, a grid 31 and a plate 32, all these being contained in a suitable evacuated vessel 33. The input circuit of this detector comprises the filament 30 and the grid 31, and these are connected in shunt, as mentioned above, to the con-

denser 21. The output circuit includes the filament 30 and the plate 32 and contains in series a suitable source of electrical energy 35, and a telephone receiver 36. In the input circuit of said detector it is desirable to insert a battery 37 in such a manner that a negative pole shall be connected to the grid. A condenser 39 is placed in shunt to the receiver 36 in order to give a low impedance path to such high frequency oscillations as pass through the output circuit.

As thus far described, this system is adapted to receive modulated oscillations and to translate them into audible signals in the receiver 36. The intensity of these signals will, however, be exceedingly low, and the purpose of the invention is to strengthen these signals. It has been found that by superimposing upon the received oscillations locally generated oscillations of identically the same frequency, such strengthening takes place. In this case the local generator 40 is inductively connected to the inductance 20 by means of the inductance 41. A combination of these impressed oscillations with the received oscillations will give a stronger signal in the receiver 36. In fact, it can be shown that, within certain limits, if B is the amplitude of the received modulated wave and A is the constant amplitude of the locally generated oscillations impressed upon the receiving circuit, the intensity of the signals received at 36 will be approximately proportional to the product of A and B.

While in this figure there is shown and described a detector of the audion type, it is to be understood that any other detector, such as a crystal rectifier, may be used although a detector of the form shown is preferred. Also, it is to be understood that while the locally generated oscillations may be set up by an independent generator of any type, such as shown at 40, one may make use of that property of amplifiers and repeaters by virtue of which they may act as generators of oscillations in themselves. Such a circuit is shown in Fig. 2, in which a coupling between the input circuit and the output circuit of this thermionic device is obtained by connecting the filament to some intermediate point 50 of the inductance 20. In this case, as is described in application of Hartley, Serial No. 31,476, filed June 1, 1915, local oscillations will be set up in this receiving circuit, the intensity and frequency of which will be determined by the point of contact 50 and by the period of the circuit as determined by 20 and 21. In this case also, it has been found convenient to insert a variable non-inductive resistance 51, which assists materially in determining the intensity of the locally generated oscillations as shown in application of Heising, Serial No. 51,761, filed September 21, 1915.

Under certain conditions it may be desirable to amplify the received oscillations prior to combining them with the locally generated oscillations. A circuit arranged for this is shown in Fig. 3, in which there is inductively connected to the antenna an amplifying circuit comprising the tuned circuit 60, 61, connected to the input circuit of a thermionic amplifier of the audion type, this input circuit including the usual heated filament 62 and grid 63, and the output circuit including the filament 62 and the plate 64 in series with a power battery 65 and an inductance 66. The usual battery 68 for polarizing the grid may also be used. Inductively connected to the inductance 66 is a detecting circuit, such as circuit D of Fig. 3. This circuit D has a circuit 20, 21 tuned to the carrier frequency and inductively coupled to inductance 66. In shunt to the condenser 21 is a detecting and generating thermionic device 33, similar in every respect to the one described in Fig. 2. The output circuit of this thermionic device 33 contains the power battery 35 and the telephone receiver 36, said receiver being shunted by the condenser 39. In series with this output circuit is also included the inductance 70 which is coupled to the coil 20, thereby arranging for the feed-back of power from the output to the input circuit, causing the circuit as a whole to generate oscillations in a manner similar to that described in connection with Fig. 2. It is to be noted that this coil 70 should be so arranged with respect to 20 that singing or generating shall be produced. While I describe and show this specific circuit D for generating local oscillations, it is to be pointed out that any suitable source of oscillations may be used, and in place of this circuit D, we may use the circuit B of Fig. 2 or the circuit of Fig. 1. In this latter case, it is, of course, obvious that a separate source of oscillations, such as 40, 41 of Fig. 1, will be required.

It is a known fact that, in view of the inherent electrostatic coupling between the input and the output circuits of an amplifier, as brought about by the elements in the vacuum tube, and in view of the electrostatic and electromagnetic coupling unavoidable in the circuit connections, there is a tendency for such an amplifier to sing, and it has been found, in the case of the amplifying circuit C, that it is desirable to prevent such singing, and for this purpose one may supply a feed-back circuit 67 connected in series in the output circuit, the windings of the coil 67 being so arranged as to nullify any tendency to sing. Such operation of an anti-singing circuit is described in the patent of Hartley 1,113,675, patented May 23, 1916, for improvements in electric circuits.

In Fig. 4 there is shown an amplifying

circuit substantially the same as that shown in Fig. 3, which amplifies the received oscillations previously to their combination with the locally generated oscillations. In this Fig. 4, there is a different arrangement of output circuit for the detector. As shown in said figure, there is placed in series with the power battery 35 a high non-inductive resistance 80. Parallel to this output circuit is a circuit containing the relatively large condenser 81 and the primary 82 of a low frequency transformer 82, 83. In shunt to the primary 82 is a circuit containing the inductance 70 and the condenser 73. The coil 70 acts to feed back high frequency power from the output to the input circuit of the vacuum tube. The condenser 73, which is of relatively low capacity, is used to prevent the short circuiting of low frequency oscillations through the coil 70. In this arrangement, the high frequency output of the vacuum tube passes through the circuit 70, 73, and the low frequency oscillations pass through the coil 82 while the direct current passes through the resistance 80.

In series with the coil 83 is the non-inductive resistance 84. In shunt to a part of the resistance 84 is the input circuit of a thermionic amplifier 85 comprising the usual heated filament 86 and grid 87. The output circuit comprises the filament 86 and the plate 88, as well as the power battery 89 and the primary 90 of a transformer 91. This transformer is a telephone repeating coil. The secondary of this repeating coil is connected to the telephone receiver 92 or to any telephone line for further transmission to remote stations. It may be advantageous to place the polarizing battery 93 in the grid circuit of the amplifier to maintain the grid at a proper potential with respect to the filament. In practice, it is desirable that the transformer 82, 83 shall be adapted to work between circuits of high impedance, and that the resistances 80 and 84 shall be large. With the thermionic detectors which I have commonly used, I find that the resistances 80 and 84 may be of the order of one hundred thousand ohms. In this last figure, it will be noted that the circuit E is used solely for amplifying the received high frequency oscillations, while the circuit F is used for combining these amplified oscillations with locally generated oscillations of the carrier frequency, and that the combination gives low frequency oscillations varying in accordance with the signal which was transmitted, and that these rectified or translated signals of audio-frequency are then amplified in the circuit G previously to being received in the telephone receiver 92. It will be noted that the feed-back coil 87 is so connected with respect to the coil 90 as to prevent singing in the same manner as described for this coil 67 in Fig. 3.

While this invention has been described in connection with a wireless telephone system, it will be obvious to one skilled in the art that the invention is not limited in all respects to such systems, but that in certain aspects it is equally well adapted to wire systems in which modulated high frequency signals are sent out from one station and received at another.

What is claimed is:

1. The method of wireless telephony which consists in radiating high frequency carrier oscillations modulated in accordance with speech, in receiving said oscillations, in generating local oscillations of said carrier frequency and combining them with the received oscillations.

2. The method of wireless telephony which consists in radiating modulated high frequency oscillations, in receiving said oscillations and combining them with locally generated high frequency oscillations of the same frequency as the received oscillations and of constant amplitude.

3. The method of high frequency signaling which consists in transmitting high frequency carrier waves modulated in accordance with speech, receiving said modulated high frequency waves, generating at the receiver oscillations of the carrier frequency, combining said locally generated oscillations with the received oscillations, impressing said combination on a detecting device, and translating the resultant combination into audible signals in accordance with the transmitted signals.

4. The method of signaling, which consists in transmitting modulated carrier oscillations, in receiving said oscillations, amplifying said oscillations, generating oscillations of the carrier frequency at the receiving station, and in combining the amplified and locally generated oscillations to reproduce the signal.

5. In a high frequency telephone receiving system, a receiving conductor adapted to receive high frequency carrier oscillations modulated in accordance with speech, a generator of oscillations of the carrier frequency, a detector, means to impress the received oscillations and the locally generated oscillations upon the input circuit of the detector, and a translating device associated with the output circuit of the detector.

6. In a high frequency telephone receiving system, a receiving conductor adapted to receive high frequency carrier oscillations modulated in accordance with speech, a generator of oscillations of the carrier frequency, a detector, a circuit to impress the received oscillations and the locally generated oscillations upon the input circuit of the detector, and a translating device associated with the output circuit of the detector.

7. In a high frequency telephone receiving system, a receiving conductor adapted to receive high frequency carrier oscillations modulated in accordance with speech, a generator of oscillations of the carrier frequency, a detector, a circuit tuned to carrier frequency to impress the received oscillations and the locally generated oscillations upon the input circuit of the detector, and a telephone receiver associated with the output circuit of the detector.

8. A high frequency telephone receiving system comprising an antenna adapted to receive high frequency carrier waves modulated in accordance with speech, a detector, a tuned circuit connected to said antenna and to the input circuit of said detector, a generator of oscillations of the carrier frequency, means for impressing said locally generated oscillations upon said input circuit simultaneously with the reception of the speech modulated oscillations.

9. A high frequency telephone receiving system comprising an antenna adapted to receive high frequency carrier waves modulated in accordance with speech, a thermionic detector of the audion type, a tuned circuit inductively connected to said antenna and connected to the input circuit of said detector, a generator of oscillations of the carrier frequency, means for impressing said locally generated oscillations upon the input circuit of said detector simultaneously with the reception of speech modulated oscillations.

10. A wireless telephone receiving system comprising an antenna adapted to receive high frequency carrier waves modulated in accordance with speech, a thermionic detector of the audion type, a local generator of oscillations of the carrier frequency, means for impressing upon the input circuit of said detector the locally generated oscillations and the received high frequency oscillations modulated in accordance with speech, and a telephone receiver associated with the output circuit of said detector.

11. In a wireless telephone receiver system, a thermionic device of the audion type, means for impressing upon the input circuit of said thermionic device received high frequency carrier oscillations modulated in accordance with speech, means for causing said thermionic device to generate oscillations of the carrier frequency and for impressing said locally generated oscillations upon the input circuit of said thermionic device simultaneously with the receipt of the modulated high frequency oscillations, and a telephone receiver associated with the output circuit of said thermionic device.

12. A system for detecting modulated carrier oscillations, said system comprising an electric discharge device having an anode, a cathode, and an impedance-controlling element, an input circuit and an output circuit, means for raising said output circuit to react upon said input circuit to set up oscillations, and means causing the frequency of the oscillations thus set up to be the same as that of the modulated carrier oscillations.

13. A signal receiving system comprising an electric discharge device having a cathode, an anode, an impedance-varying element, an input circuit and an output circuit, means for impressing upon said input circuit carrier oscillations modulated in accordance with variable low frequency waves, means for causing said discharge device to generate oscillations of the carrier frequency and for impressing said locally-generated oscillations upon said discharge device simultaneously with said modulated oscillations, and signal-reproducing means associated with said output circuit.

14. A receiving system comprising a detector, means for impressing upon the input circuit of said detector carrier oscillations modulated in accordance with a relatively low frequency wave, a local generator of oscillations of the carrier frequency, means for impressing upon said detector the locally-generated oscillations and the modulated oscillations, and a translating device associated with the output circuit of said detector for receiving and utilizing the detected oscillations.

15. A receiving system comprising means for amplifying weak oscillations, means for impressing the received oscillations modulated in accordance with a low frequency wave upon said amplifying means, a local generator of oscillations of the frequency of said modulated oscillations, translating means for obtaining low frequency waves from oscillations modulated in accordance with waves of said low frequency, and means for impressing said received modulated oscillations and said locally-generated oscillation simultaneously upon said translating means.

16. A telephone receiving system comprising means for amplifying weak oscillations, means for impressing received oscillations modulated in accordance with speech upon said amplifying means, a local generator of oscillations of the frequency of said received oscillations, translating means for obtaining low frequency waves from oscillations modulated in accordance with waves of said low frequency, and means for impressing said received oscillations and said locally-generated oscillations simultaneously upon said translating means.

In witness whereof, I hereunto subscribe my name this 26th day of November A. D., 1915.

BURTON W. KENDALL.

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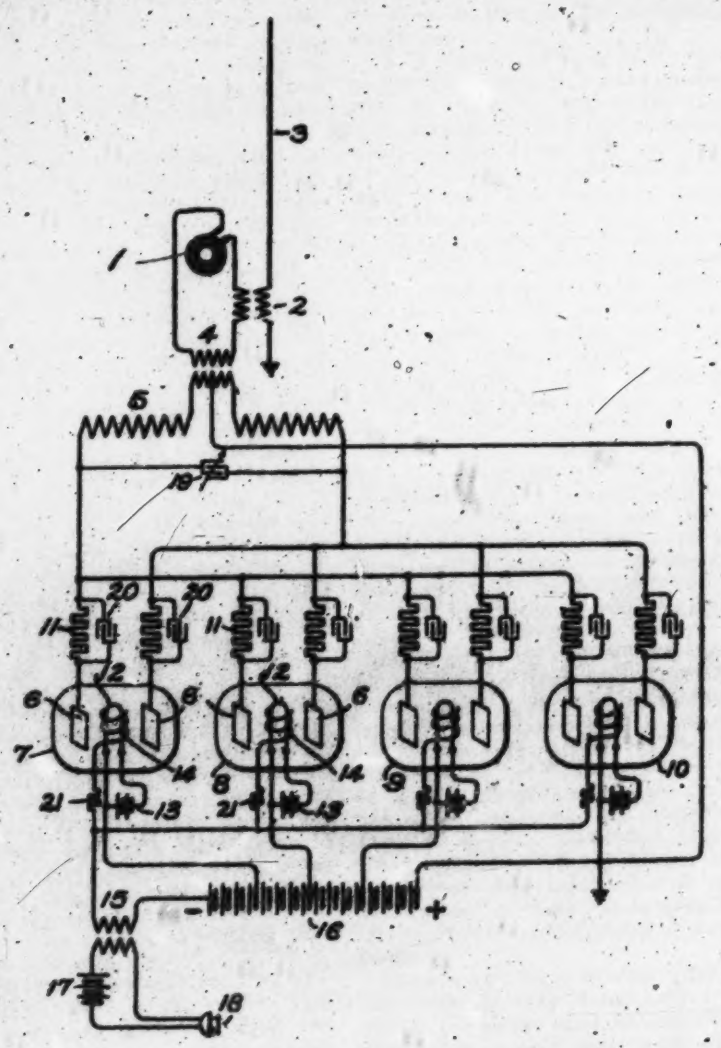
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E. F. W. ALEXANDERSON.

METHOD OF AND MEANS FOR CONTROLLING ELECTRICAL ENERGY.

APPLICATION FILED JUNE 15, 1914. RENEWED SEPT. 24, 1919.

1,340,101. Patented May 11, 1920.



Witnesses:
Chas. B. Stokes
J. Ellis Glen

Inventor:
Ernst F. W. Alexanderson,
by Albert G. Davis
His Attorney

UNITED STATES PATENT OFFICE.

ERNST F. W. ALEXANDERSON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METHOD OF AND MEANS FOR CONTROLLING ELECTRICAL ENERGY.

1,340,101. Specification of Letters Patent. Patented May 11, 1920.

Application filed June 18, 1914, Serial No. 845,115. Renewed September 24, 1919. Serial No. 326,969.

To all whom it may concern:

Be it known that I, ERNST F. W. ALEXANDERSON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Methods of and Means for Controlling Electrical Energy, of which the following is a specification.

My present invention relates to a method of and means for controlling electrical energy and more particularly to the control of energy used for transmitting signals through space. While in the description which follows I have illustrated its utility when applied to wireless telephony, it is capable of use for other purposes as well.

In a copending application, Serial No. 833,433, filed April 30, 1914, I have described and claimed a system of wireless signaling in which a comparatively large amount of energy may be controlled by means of the feeble current set up in an ordinary telephone transmitter. In this case the amount of energy transmitted to the antenna from a local source of high frequency current is varied by means of a relay or electron discharge device which is controlled by the current from a telephone transmitter in such a way as to vary its conductivity. With this arrangement, in order to produce the desired variation in the antenna current, it is necessary that a considerable amount of the total energy of the local source shall be absorbed in the relay circuit. In all of the modifications shown in my prior application the greater part of the energy is absorbed in the relay itself. Hence the amount of energy which may be effectively communicated to the antenna is limited by the absorptive capacity of the relay used. At the present time this capacity is limited by difficulties which appear to be inherent in the manufacture of apparatus of this type.

The energy which may be controlled in such a system might be increased by connecting several relays in parallel, in which case the amount which could be controlled would vary directly as the number of relays used. By connecting the relays in parallel with resistance in series therewith according to my invention however the amount of energy which can be controlled will vary substantially as the square of the number of relays used.

My invention will best be understood by reference to the following description taken in connection with the accompanying drawing in which I have shown diagrammatically a system of connections whereby the desired result may be accomplished. As here indicated a source of high frequency energy 1 is connected through the usual transformer 2 with the antenna 3. The primary 4 of an oscillation transformer is also connected in series with the source 1 and the primary of transformer 2. The terminals of the secondary 5 of the oscillation transformer are connected to the anodes 6 of a series of electron discharge devices or relays 7, 8, 9, 10 through resistances 11 as shown. These relays also comprise filamentary cathodes 12 with local sources of current 13 for heating the same. The cathodes are surrounded by grid-shaped conducting bodies 14. The grids are all connected to one terminal of the secondary of transformer 15, to the other terminal of which is connected a battery 16 and the cathodes are connected to various points in the battery. One end of the battery is preferably grounded as shown. The primary circuit of transformer 15 includes a source of direct current 17 and a telephone transmitter 18. The cathodes are also connected to the middle point of the secondary 5 of the oscillation transformer. An adjustable condenser 19 is preferably connected across the terminals of the secondary of the oscillation transformer 5, although in some cases the capacity of the relays may be great enough so that this will not be required.

With the arrangement here shown it will be seen that the current in the antenna will vary in accordance with the current through the primary 4 of the oscillation transformer. The amplitude of the current in the primary 4 will in turn depend upon the current flowing in the secondary circuit. It will be apparent that a certain proportion of the energy from the source 1 will be diverted to the secondary circuit and absorbed in the resistances and the relay devices therein. The system may be so designed and adjusted that the energy thus absorbed will in general bear a certain ratio to the total amount of energy derived from the source 1.

hance by varying the amount of energy absorbed in the secondary circuit the amplitude of the antenna current will be varied in substantially the same proportion.

The relays used may assume a great variety of forms. In the form of relay indicated in the present case there will normally be a flow of negative electricity from the cathode to the anodes but no flow of current in the opposite direction. The amplitude of the current flow through the relay may be varied by varying the potential impressed upon the grids 14. If a large enough negative potential is impressed thereon the flow of current may be stopped altogether. If a positive potential is impressed upon the grids the current flow will be increased. For convenience of description it will be assumed that the potential of the grid 14 is such that little or no current will flow through the relay 7 when the high frequency potential of the secondary 5 of the oscillation transformer is applied to the electrodes. The negative potential of the grids of the relays 8, 9 and 10 with respect to their cathodes will be progressively greater. If now a current wave is produced in the transformer 15 of such a direction as to overcome the negative potential of the grids 14, current will begin to flow first through the relay 7 and will gradually increase to a maximum value. If the potential of the current wave is great enough it will gradually overcome the negative potential of all of the grids and current will begin to flow successively in relays 8, 9 and 10. It will of course be understood that when the voltage impressed upon the grids from the transformer 15 begins to decrease the reverse action will take place, that is, current will cease to flow first in relay 10, next in relay 9 and so on until the impressed potential falls to zero and no current will flow as in the beginning. The relays may be so designed and the potentials applied thereto so chosen that when the current in relay 7 reaches its maximum, current will begin to flow in relay 8 and when the current in relay 8 reaches its maximum, current will begin to flow in relay 9 and so on.

Relay devices of the general type shown herein vary somewhat in their characteristics and in some cases the proportionality between the current flow and the voltage impressed upon the grid is constant only over a somewhat limited range. In such cases it may be desirable to so choose the potentials applied to the grids that before the current in one relay has reached its maximum, current will begin to build up in the next relay and so on. In this way the system may be so designed that the current flow therein will be substantially proportional to the voltage variation in the transformer 15 throughout the entire range.

When current first begins to flow in the relay circuit the greater part of the drop in potential will occur in the relay itself and hence the relay will be called upon to absorb most of the energy of the secondary circuit. As the current increases however the drop through the resistances 11 will increase and the proportionate amount of energy absorbed by the relay will decrease. The maximum energy which the relay will be required to absorb will be when the current has reached one-half of its maximum value and the relay is consuming one-half of the voltage. When the current reaches its maximum value in the relay the amount of energy which the relay will be required to absorb will be practically negligible, the principal drop being in the resistance.

Suppose, for example, that it is desired to control in the secondary circuit a maximum of 10 kilowatts of energy which may be represented by .5 ampere at 20,000 volts. If we do this with a single relay and secure a gradual regulation of the energy from no load to full load, the relay will be called on to consume a maximum of .25 ampere at 10,000 volts or 2.5 kilowatts. It will also be required to absorb energy during the entire period during which the change from minimum to maximum takes place.

Suppose now it is desired to control a maximum of 160 kilowatts of energy which is represented by 8 amperes at 20,000 volts. If we use four relays as indicated in the drawing each relay will be called upon to take 2 amperes. The maximum amount of energy which any one relay will be called upon to absorb will be 1 ampere at 10,000 volts or 10 kilowatts. The change from minimum to maximum in each relay however will occur in one-quarter of the time required in the case where a single relay was used. Hence the average amount of energy absorbed will be only one-quarter of 10 or 2.5 kilowatts. Thus it will be seen that four relays of the same capacity will be able to control 16 times as much energy as the single relay.

In the type of relay here shown there is an appreciable capacity between the anodes. This results in considerable current flowing through the relay between the anodes when the system is not being used for transmitting signals. As a result a large amount of energy is needlessly wasted in the resistances 11. In order to avoid this it may be desirable to shunt each of these resistances by a condenser 20. This will cut down the high frequency alternating current but will not interfere with the unidirectional flow of current through the relay between the cathode and anodes. It will of course be understood that the resistance 11 may equally well be inserted in series with the cathode instead of in series with the anodes.

In order to prevent the grids 14 from consuming an unnecessary amount of current when they become highly positive, resistances 21 may be inserted in series therewith.

While in the preceding description I have described the application of my system with high vacuum relays which are especially adapted for use with high voltages and low currents, my invention is by no means limited to use with this type of relay. It is equally applicable with relays adapted for lower voltages and larger currents and in which there are appreciable amounts of gas or vapor present.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The method of varying the amplitude of the current flow in a circuit comprising a plurality of parallel paths, each of which contains a relay device, which consists in gradually varying the conductivity of each one of the paths in succession by varying the electrical field of the relay device therein.

2. The method of varying the amplitude of the current flow in a circuit comprising a plurality of parallel paths each of which contains a resistance and a relay device, which consists in gradually varying the conductivity of each one of the paths in succession by varying the electrical field of the relay devices therein.

3. The method of varying the amplitude of the current flow in a circuit which comprises a plurality of parallel paths each of which contains a relay device, which consists in gradually varying the conductivity of each one of the relay devices in succession.

4. The method of transmitting signals by varying the amplitude of the current flow in a circuit which comprises a plurality of parallel paths, which consists in gradually varying the conductivity of each one of the paths in succession between minimum and maximum values and maintaining the maximum value in at least one of the paths while varying the conductivity of the others.

5. The method of varying, in accordance with signals to be transmitted, the amplitude of current flow in an antenna having a source of energy connected thereto, which consists in diverting a certain proportion of the energy from said source through a circuit containing a plurality of parallel paths and gradually varying the conductivity of each one of said paths in succession in accordance with the signals to be transmitted.

6. The method of varying the amplitude of current flow in an antenna having a source of energy connected thereto, which consists in diverting a certain proportion of energy from said source through a circuit containing a plurality of parallel paths and gradually varying the conductivity of each one of said paths in succession.

7. The method of varying the flow of current in a circuit connected to a source of energy and having a series of relay devices connected thereto in parallel, which consists in so varying the electrical field in the relay devices that the current flow therein will very successively in the same series from a minimum to a maximum.

8. The combination in a wireless signaling system of a source of high frequency electrical energy, an oscillation transformer in series therewith, a plurality of relay devices connected in parallel to the secondary of said transformer and means for varying the electrical field in said relay devices to successively vary the current flow therethrough from a minimum to a maximum.

9. The combination in a wireless signaling system of an antenna, a source of energy connected thereto, a secondary circuit comprising a plurality of parallel paths for diverting a certain proportion of the energy from said source, a relay device in each of said parallel paths and means for varying the conductivity of each of said paths in succession.

10. The combination in a wireless signaling system of an antenna, a source of energy connected thereto, a secondary circuit comprising a plurality of parallel paths for diverting a certain proportion of the energy from said source, a relay device in each of said parallel paths, and means for successively varying the electrical field in each of said relay devices in accordance with the signals to be transmitted.

11. The combination in a wireless signaling system of an antenna, a source of energy connected thereto, a secondary circuit comprising a plurality of parallel paths for diverting a certain proportion of the energy from said source, and means for varying the conductivity of each of said paths in succession in accordance with the signals to be transmitted.

12. The combination in a wireless signaling system of an antenna, a source of energy connected thereto, a secondary circuit comprising a plurality of parallel paths for diverting a certain proportion of energy from said source, a relay device comprising a plurality of electrodes in each of said parallel paths, a conducting body interposed between the electrodes in each of said relay devices, means for normally impressing a different potential upon each of said conducting bodies, and means for varying the potential impressed upon said conducting bodies.

13. The combination in a wireless signaling system of an antenna, a source of high frequency electrical energy connected thereto, a secondary circuit comprising a plurality of parallel paths for diverting a certain proportion of the energy from said source, a relay device comprising a plurality of

electrodes in each of said parallel paths, a conducting body interposed between the electrodes of each of said relay devices, and means for successively varying the potential of said conducting bodies in such a way as to successively vary the current flow through said relay devices from a minimum to a maximum.

14. The combination in an electrical distribution system of a source of high frequency alternating current, a circuit connected thereto comprising a plurality of parallel paths each of which contains a relay device, and means for gradually varying the conductivity of each one of the relay devices in succession.

15. The combination in an electrical distribution system of a source of high frequency alternating current, a circuit connected thereto comprising a plurality of parallel paths each of which contains an electron discharge device, and means for varying the conductivity of each one of said electron discharge devices in succession.

16. The combination in a high frequency signaling system of a signaling circuit, a source of high frequency energy connected thereto, a secondary circuit for diverting a portion of the energy from said source, a relay device in said circuit for varying the amount of energy diverted and a resistance in series with said relay device for absorbing a portion of the energy diverted.

17. The combination in a high frequency signaling system of a signaling circuit, a source of high frequency energy connected thereto, a secondary circuit for diverting a portion of the energy from said source, a relay device comprising a plurality of electrodes interposed in said secondary circuit, a conducting body interposed between the electrodes of said relay, means for impressing a variable potential upon said conducting body to vary the amount of energy diverted from said source and a resistance in series with said relay device for absorbing a portion of the energy diverted.

18. The combination in an electrical distribution system of a source of high frequency alternating current, a circuit connected thereto for diverting a variable amount of energy from said source, an electron discharge device in said circuit, means for varying the conductivity of said electron discharge device to vary the amount of energy diverted and a resistance in series with said electron discharge device for absorbing a portion of the energy diverted.

19. The combination in an electrical distribution system of a source of high frequency alternating current, a circuit connected thereto comprising a plurality of parallel paths each of which contains an electron discharge device, means for varying the conductivity of each one of said electron discharge devices in succession and resistances in series with said electron discharge devices for absorbing a portion of the energy in the circuit.

20. Means for controlling the flow of high frequency alternating current in a circuit comprising a plurality of parallel paths comprising a relay device having a cathode and an anode in each of said paths, a current controlling member interposed between said cathode and anode in each of said devices, for gradually varying the current flow therethrough, means for impressing a variable potential upon said controlling members and resistances in series with said relay devices for absorbing a portion of the energy in the circuit.

In witness whereof I have hereunto set my hand this 19th day of June, 1914.

ERNST F. W. ALEXANDERSON.

Witnesses:

BENJAMIN B. HULL,

HELEN ORROM.

Certification in Letters Patent No. 1,340,101.

It is hereby certified that in Letters Patent No. 1,340,101, granted May 11, 1920, upon the application of Ernst F. W. Alexanderson, of Schenectady, New York, for an improvement in "Methods of and Means for Controlling Electrical Energy," an error appears in the printed specification requiring correction as follows: Page 3, line 49, claim 5, for the word "fow" read *flow;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of July, A. D., 1920.

[SEAL.]

M. H. COULSTON,

Acting Commissioner of Patents.

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H. J. VAN DER BIJL.
HIGH FREQUENCY SIGNALING.
APPLICATION FILED AUG. 21, 1915.

1,350,758. Patented Aug. 24, 1920.

Fig. 1.



Fig. 2.



Fig. 3.

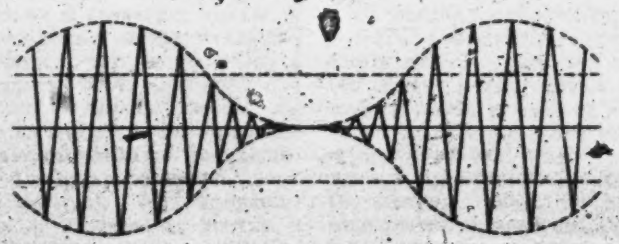
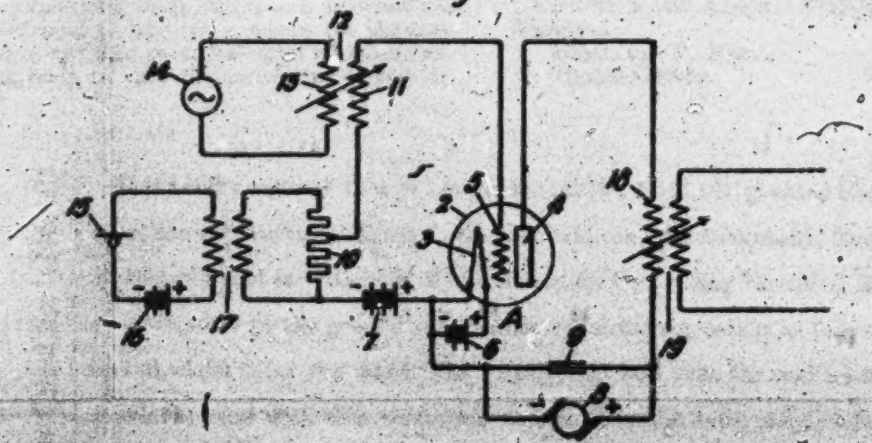


Fig. 4



Witnesses:
Geo. Sullé
O. Ramm

Inventor:
Hendrik J. van der Bijl.
by J. S. Roberts
Atty.

UNITED STATES PATENT OFFICE.

HENDRIK JOHANNES VAN DER BIJL, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

HIGH-FREQUENCY SIGNALING.

1,350,752. Specification of Letters Patent. Patented Aug. 24, 1920.

Application filed August 21, 1915. Serial No. 46,662.

To all whom it may concern:

Be it known that I, HENDRIK JOHANNES VAN DER BIJL, a subject of the King of Great Britain, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in High-Frequency Signaling, of which the following is a full, clear, concise, and exact description.

This invention relates to signaling by high frequency electrical oscillations or waves along wires or through space, and more particularly it relates to a system for modulating high frequency oscillations in accordance with the frequency and amplitude variations of message waves to be transmitted, and its object is to effect this modulation without destroying the quality characteristics of the message wave.

The invention provides for modulating feeble high frequency oscillations by impressing the currents of telephonic frequencies, together with the high frequency oscillations, on the input circuit of a thermionic amplifier; and makes use of the fact that the amplification of a thermionic amplifier of the audion type depends upon the voltage impressed upon the grid or input circuit. If the amplifying power of the tube for the high frequency oscillations is caused to vary in accordance with the variations of the electromotive force of the telephonic waves of low frequency, the desired modulation is obtained, for there will be produced a high frequency wave the envelop of which is an accurate reproduction of the telephonic wave, and this wave may then be further amplified to any required degree for effective radiation from an antenna.

This will be better understood by reference to the accompanying drawing, in which Figure 1 shows the characteristic curve of a thermionic amplifier of the audion type; Fig. 2 illustrates the form of current curve in the output circuit; Fig. 3 illustrates the current curve in the radiating system; and Fig. 4 shows an arrangement of apparatus to obtain the desired results.

Perfect modulation refers to such a variation in the amplitude of the envelop of the high frequency wave that this envelop is an accurate picture of the low frequency modulating wave.

According to the present invention, the maximum negative value of the low frequency input wave is made just sufficient to reduce the modulated high frequency oscillations to zero amplitude. In other words, the picture of the low frequency oscillations, as shown in the envelop of the high frequency oscillations, just comes down to the zero line, having none of the picture cut off by this zero line.

The process of modulation will be made more evident by a consideration of the characteristic curve shown in Fig. 1, which gives the relation between the output current and the input voltage of the type of amplifier used. In this curve the abscissæ represent the input voltage and the ordinates represent the output current.

If we consider the effect at two different points, C and F, of adding equal positive voltages, CD and FG, on the grid, it is clear that the increase in space current by these equal increments in grid voltage is considerably greater at F than it is at C. The amplification will then be greater at F than at C. Now suppose that the line CD, or the equal line FG, represents a small increment of the high frequency voltage, while the space current, due to the battery in the output circuit, is varied by the low frequency voltage impressed on the grid from point C to point F. It is evident, then, that the amplification of the high frequency will be increased as the potential at which the grid is maintained by the low frequency is increased from point C toward the point F of the figure.

If we suppose the normal grid voltage, when neither high frequency nor low frequency input is applied, to be such that the space current is given by AM, then when the low frequency is applied, assuming it to have equal positive and negative values, the line [illegible] will be moved equal horizontal distances [illegible] at A, the [illegible] will depend upon the point of the characteristic at which the amplifier is working; that is, upon the form of the low frequency voltage curve, and will in fact be proportional to the slope of the characteristic at the point in question.

If now, high frequency oscillations are

also impressed upon the grid circuit, the high frequency current in the output circuit will depend in magnitude upon the amount of amplification, that is, upon the part of the characteristic at which the amplifier is working and therefore upon the form of the low frequency voltage curve.

Theoretically, for perfect modulation the low frequency should be large compared with the high frequency input to the modulator, in order that the amplifying power shall not change appreciably due to the high frequency oscillations, but shall be subject to the low frequency voltage only. From a theoretical standpoint the best value for the ratio is infinity, but of course this is not practical, and it has been found that a sufficiently good modulation can be secured if the low frequency voltage input is from three to ten times as large as the high frequency voltage input.

Perfect modulation further requires that the characteristic curve be parabolic, in which case the space current will be proportional to the square of the input voltage, as measured from B. Under these conditions the slope of the curve, which is a measure of the amplifying power, increases linearly from the point B to the point L. Under these conditions, the current in the output circuit of the modulator will have the form shown in Fig. 2 when a sinusoidal low frequency is impressed.

When the low frequency has been dropped out as the energy is passed along through an oscillation transformer, which transmits efficiently only the high frequency output of the modulator, there will remain a high frequency current of the form shown in Fig. 3, the dotted line showing the axis of the sinusoidal envelop of the high frequency oscillations.

In view of the above it has been found desirable to generate high frequency carrier waves of a power commensurate with, or at least not greater than, that of the low frequency signaling waves to be transmitted. Where the signal waves are of low intensity, as is the case where a commercial transmitter is their source, it follows that the generated oscillations should be of an equally low or lower intensity in order that they may be effectively modulated by the telephone currents.

The arrangement of apparatus which I have found useful for the desired purpose will be clearly understood by reference to Fig. 4, in which A is a thermionic amplifier comprising an evacuated vessel 2 which incloses the cathode 3, anode 4 and an auxiliary electrode 5. Cathode 3 is heated to incandescence by the battery 6 and is maintained positive with respect to electrode 5 by means of battery 7. The normal potential of the grid is therefore at some such point as M in Fig. 3, such that the most negative grid potential resulting from the low frequency modulating wave will be just sufficient to carry the space current to zero as at point B. The space current flowing between cathode 3 and anode 4 may be supplied from a direct current generator 8 having in shunt with it a condenser 9 sufficiently high in capacity to afford a path of low impedance for both the low and high frequency currents. The input circuit of the amplifier A includes the cathode 3, battery 7, potentiometer 10, secondary 11 of the oscillation transformer 12 and the electrode 5. The primary 13 of transformer 12 is connected to a high frequency generator 14, which may be of any suitable type, such, for example, as that described in an application of Hartley, Serial No. 31,476, filed June 1, 1915. A telephone transmitter 15 is connected in series with a battery 16 in the primary circuit of a transformer 17, whose secondary is connected to the potentiometer 10 in the input circuit of the amplifier. The output circuit of the amplifier includes the anode 4, winding 18 of the oscillation transformer 19, the condenser 9 and generator 8 in parallel, and the cathode 3.

In the absence of any telephonic impulses, the arrangement described serves simply to produce in this output circuit high frequency currents having substantially the same wave form as that produced by the generator 14, but of greater amplitude.

When, however, telephonic electromotive forces are impressed on the input circuit by means of the transformer 17, the electrode 5 will be made more or less negative with respect to the cathode 3, as the telephonic wave fluctuates from a negative to a positive value. This variation in the potential of the electrode 5 has the effect of varying the amplifying power of the amplifier in accordance with variations in the telephonic electromotive forces. Since the amplification produced by the tube depends upon the relative values of the internal resistance of the tube and the external impedance into which it works, it may be considered that the variation in the potential of the electrode 5 has the effect of varying the impedance of the electron discharge path between cathode 3 and anode 4, and as this path is included in the output circuit of the amplifier, it follows that the impedance of the output circuit is varied in accordance with variations in the telephonic electromotive forces. Thus, there will be produced in the winding 18 of the transformer 19 a high frequency current whose amplitude varies with the variation in amplitude of the impressed telephonic electromotive force, that is, the envelop of the high frequency wave will be an accurate reproduction of the telephonic wave.

Since it is desirable that the power value of the impressed telephonic wave shall be greater than that of the generated high frequency oscillations, it will appear that the power value of the modulated high frequency waves produced in the transformer 19 may well be insufficient for effective radiation from an antenna. In such case the power may be amplified to the degree required for radiation by means of some such arrangement as that described in patent to Arnold No. 1,129,942, March 2, 1915. On the other hand, it may well be that the high frequency oscillations have a fairly large power to start with, and in this case it may be necessary to amplify the telephonic power before impressing the two upon a common amplifier.

It has been found desirable to have the external impedance of the output circuit fairly small in order that the characteristic curve of the amplifier shall not be materially altered as the current in the output circuit changes.

While in the present instance the transformer 17 is shown directly connected to a telephone transmitter 15, it is to be understood that this transformer may be connected to a telephone line and serve as a means for relaying, to a wireless antenna or other high frequency signaling system, telephonic or other messages received over long distance conduct rs. It is also evident that the arrangement shown is suitable for telegraphic transmission by simply substituting a telegraph key for the transmitter 15 and adding an interrupter of any desired frequency. It is evident also that although this invention is particularly well adapted for use in signaling systems, which constitutes the principal application for modulated currents, in its broader aspects the invention may be used wherever it is desired to modulate waves or periodic disturbances, regardless of the use which is to be made of the modulated current or the medium in which the disturbances are produced.

What is claimed is:

1. The method of modulating carrier waves which consists in generating carrier waves of substantially constant amplitude, and invariably amplifying the amplitude of said carrier waves in accordance with a signal.

2. The method of modulating carrier current which comprises generating a high frequency carrier wave of substantially constant amplitude, simultaneously generating a low frequency wave and variably amplifying the high frequency wave in accordance with said low frequency wave.

3. The method of modulation which comprises generating a current of high frequency, generating a current of relatively low frequency, impressing energy from each of these currents in series upon a circuit, generating space current and causing the energy impressed upon said circuit to vary said space current, said variations being of the frequency of said carrier current but having greater amplitudes, the amplification varying in accordance with the variations of said low frequency current.

4. The method of modulating a high frequency carrier current by means of a space discharge amplifier having an input circuit and an output circuit, the amplifying power of which varies with the energy supplied to the input circuit, which comprises generating a high frequency carrier wave, generating a low frequency wave, and impressing said high frequency wave and said low frequency wave simultaneously and in series upon the input circuit of the amplifier.

5. The method of modulating high frequency carrier current which consists in producing a high frequency carrier wave, simultaneously producing a low frequency wave of greater amplitude than said high frequency wave and variably amplifying said high frequency wave in accordance with said low frequency wave.

6. The method of modulation which consists in generating a high frequency wave, simultaneously generating a low frequency wave having an amplitude at least as great as that of said high frequency wave and variably amplifying said high frequency wave in accordance with said low frequency wave.

7. The method of operating a thermionic amplifier having a cathode, an anode, a space current control means, input and output circuits and a source of space current in said output circuit, which method comprises simultaneously impressing upon said control means a series of high frequency waves and a series of low frequency waves and a constant potential, and so adjusting the apparatus that the space current in said output circuit periodically falls to substantially zero value.

8. The method of signaling which comprises generating a series of waves and subsequently simultaneously amplifying and modulating each of the waves in accordance with a signal.

9. In a system for radio-transmission, a source of high frequency oscillations, an amplifier having an input circuit and an output circuit, means for impressing said high frequency oscillations on said input circuit, a primary source of low frequency currents, and a path of variable impedance in said output circuit controllable by said low frequency currents.

10. In a system for radio-transmission, a source of high frequency oscillations, an amplifier for said oscillations having an in-

put circuit, and a primary source of low frequency currents connected with said input circuit whereby the amplification of said oscillations is made to vary in conformity with variations in said low frequency currents.

11. In a system for radio-transmission, a thermionic amplifier having an input circuit, a source of high frequency oscillations connected with said input circuit, and a primary source of low frequency electromotive force also connected with said input circuit.

12. The combination with a source of low frequency currents, of a source of high frequency oscillations, means for amplifying said oscillations comprising an evacuated vessel containing an electron-emitting cathode, an anode and an auxiliary electrode, an input circuit including said cathode and said auxiliary electrode, means for impressing said oscillations on said input circuit, and a connection between said low frequency current source and said input circuit in series with said means.

13. The combination with a source of low frequency signal impulses, of a generator of high frequency oscillations, means for amplifying said oscillations comprising a thermionic repeater having an input circuit and an output circuit, a high frequency transformer having its primary connected to said generator and its secondary included in said input circuit, a low frequency transformer having its primary connected to said low frequency source and having its secondary connected to said input circuit in series with the secondary of said high frequency transformer.

14. The combination with an electric discharge device having main electrodes and an impedance controlling means, of an output circuit for said device, a source of current for said output circuit, and means for simultaneously impressing upon said controlling means high frequency waves and low frequency waves, auxiliary means for impressing a substantially constant pressure upon said controlling means, the relative magnitudes of the waves and the constant pressure being such that the discharge current periodically fails to substantially zero value at the frequency of said low frequency waves.

15. The combination with an amplifier having the property of variably amplifying in accordance with the energy impressed thereupon, of a source for impressing energy upon said amplifier, means for simultaneously impressing high frequency waves and low frequency waves upon said circuit, the amplitude of said high frequency waves being less than the amplitude of said low frequency waves.

16. The combination with an amplifier having the property of variably amplifying in accordance with the energy impressed thereupon, of means for simultaneously impressing high frequency waves and low frequency waves upon said amplifier, said waves of low frequency having an amplitude at least as great as that of said waves of high frequency.

17. In a modulating system, the combination with a source of high frequency oscillations, of means for modulating said oscillations, said means comprising a device asymmetrically conducting for said high frequency oscillations and an impedance varying element therefor, said means being free from contact resistance.

18. The combination with a space discharge device, of a source of space current therefor, a source of carrier waves acting upon said device, a source of low frequency signaling waves acting upon said device, means associated with said device for causing said carrier waves to impress variations of their own frequency upon said space current, and means for transforming said variable current into alternating current of carrier frequency modulated in accordance with said low frequency signaling waves.

19. The combination with a source of high frequency waves, a source of low frequency waves, a source of space current, and means for varying an impedance presented to said space current, said means being controlled by both the high and the low frequency waves, and means whereby the effect of said high frequency waves upon the impedance presented to said space current is varied periodically by said low frequency waves.

20. In a high frequency signaling system, a source of high frequency oscillations, and a power amplifier having a curved characteristic for modulating and amplifying said oscillations in accordance with a signal.

21. In a transmission system, a source of high frequency oscillations, power amplifying means for modulating said oscillations and means for impressing said high frequency oscillations upon said amplifying means, the amplifying power of said means being substantially independent of the amplitude of the impressed high frequency oscillations.

22. In a modulating system, the combination with a source of high frequency oscillations, of means for modulating said oscillations, said means comprising a space discharge device and an impedance varying element therefor, said means being free from contact resistance.

23. The combination with an electric discharge device having main electrodes and an impedance-controlling means, of an input circuit and an output circuit each connected to said device, a source of high frequency

electromotive force, a source of low frequency electromotive force, means for connecting each of said sources to said input circuit, said connecting means substantially preventing either of said sources from affecting the electromotive force impressed by the other, and said device having an amplifying power substantially proportional to the amplitude of the impressed low frequency electromotive force.

24. The combination with a modulator having an input circuit of high impedance, of means for impressing high frequency impulses upon said circuit, means in series with said last-mentioned means for impressing low frequency impulses upon said circuit, and means to reduce the impedance effect of one of said means upon the impulses impressed upon said circuit by the other of said means.

25. The combination with a modulator having an input circuit of high impedance, of a transformer for impressing high frequency impulses upon said circuit, a second transformer in series with said first-mentioned transformer for impressing low frequency impulses upon said circuit, a resistance element in series with said transformers in said circuit, and a second resistance element in parallel circuit arrangement with said first resistance element and one of said transformers.

26. In a system of communication, a generator providing a source of high frequency oscillations, a source of signal oscillations, an asymmetrically conducting thermionic device having a constantly active source of electrons, an input circuit and an output circuit, means for impressing oscillations from both of said oscillation sources upon the input circuit of said thermionic device, and a high frequency transmission circuit associated with the output circuit of said device.

27. The method of producing modulated waves, which comprises producing a carrier wave, amplifying said carrier wave and simultaneously varying the amplification of said carrier wave so as to make it substantially proportional to the amplitude of a low frequency wave.

28. The method of producing modulated waves which comprises producing a carrier wave, amplifying said carrier wave and simultaneously controlling the amplification of said carrier wave substantially exclusively in accordance with a low frequency wave.

29. The method of producing modulated waves which comprises impressing a carrier wave upon an amplifier to produce an amplified carrier wave and simultaneously impressing upon said amplifier another wave of much larger amplitude than said impressed carrier wave in order to control the magnitude of the amplified carrier wave.

30. The method which comprises simultaneously subjecting a thermionic device having a variable amplifying power to the action of a high frequency wave, and a low frequency wave, the amplitude of the high frequency wave being insufficient to cause considerable change in the amplifying power of said amplifier and the amplitude of the low frequency wave being sufficient to cause large change in the amplifying power of said amplifier.

31. The method of operating a thermionic discharge device having a cathode, an anode and an impedance control element, an input circuit connected to said cathode and said impedance control element and an output circuit connected to said cathode and said anode, which method comprises impressing a high frequency electromotive force upon said input circuit, simultaneously impressing an electromotive force between said control element and said cathode, negatively directed with respect to said control element, and varying at a low frequency rate the effective value of said negatively directed electromotive force.

32. The method of producing a modulated wave which comprises impressing a carrier wave upon a thermionic amplifier having a curved characteristic and simultaneously impressing upon said amplifier an electromotive force varying at a low frequency and of a magnitude within a range throughout which the curved characteristic is substantially parabolic.

33. In combination, means for producing a carrier wave, means connected thereto for amplifying said carrier wave, means for producing a low frequency wave connected to said amplifying means and means associated therewith whereby the amplification of said carrier wave may be made substantially proportional to the amplitude of said low frequency wave.

34. In combination, means for producing a carrier wave, means connected thereto for amplifying said carrier wave, means connected to said amplifying means for controlling the amplification of said carrier wave substantially exclusively in accordance with a low frequency wave.

35. Means for producing a carrier wave, an amplifier connected to said means, and means for impressing upon said amplifier another wave of amplitude large compared with that of said impressed carrier wave in order to control the magnitude of the amplified carrier wave.

36. In combination, an amplifier having a variable amplifying power, a high frequency source and a low frequency source, means connecting said sources to said amplifier to simultaneously impress thereon high frequency waves and low frequency waves, the amplitude of the impressed high fre-

quency waves being insufficient to cause considerable change in the amplifying power of said amplifier and the amplitude of the impressed low frequency waves being sufficient to cause large change in the amplifying power of said amplifier.

87. A thermionic discharge device having a cathode, an adode and an impedance control element, an input circuit connected to said cathode and said control element, an output circuit connected to said cathode and anode, a high frequency source connected to said input circuit, means for impressing a negative electromotive force upon said control element with respect to said cathode, and means for varying at a low frequency rate the effective value of said negative electromotive force.

88. In combination, a thermionic amplifier having a curved characteristic, means for impressing thereon a carrier wave, means for simultaneously impressing upon said amplifier an electromotive force varying at low frequency and having an amplitude within a range throughout which said curved characteristic is substantially parabolic.

In witness whereof, I hereunto subscribe my name this 20th day of August, A. D., 1915.

HENDRIK JOHANNES VAN DER BIJL.

Corrections in Letters Patent No. 1,350,752.

It is hereby certified that in Letters Patent No. 1,350,752, granted August 24, 1920, upon the application of Hendrik Johannes van der Bijl, of New York, N. Y., for an improvement in "High-Frequency Signaling," errors appear in the printed specification requiring correction as follows: Page 3, line 53, claim 1, for the word "invariably" read *to variably* (two words); page 6, line 8, claim 87, for the word "adode" read *anode;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of November, A. D., 1920.

[SEAL.]

L. B. MANN,
Acting Commissioner of Patents.

Cl. 177—172.

1514

L. DE FOREST.

MEANS FOR AMPLIFYING CURRENTS.

APPLICATION FILED JUNE 24, 1913.

1,375,447. Patented Apr. 19, 1921.

2 SHEETS—SHEET 1.

Fig. 1

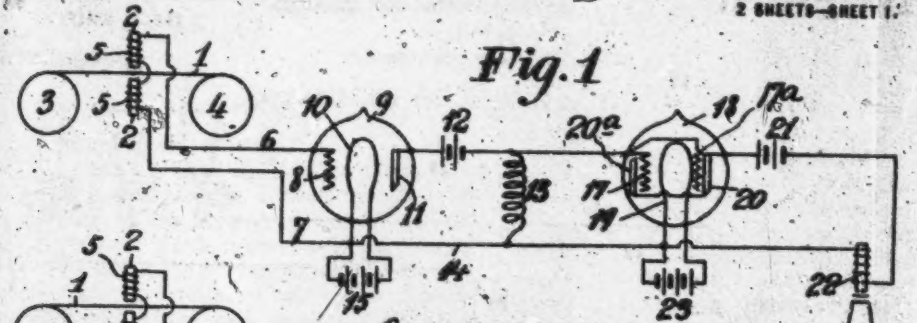


Fig. 2

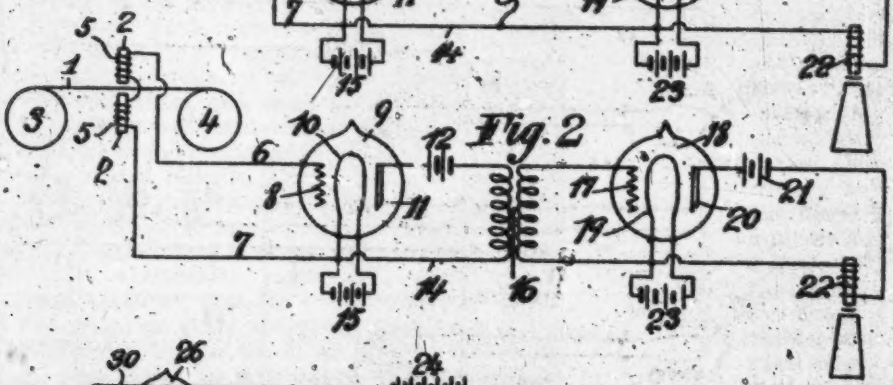


Fig. 3

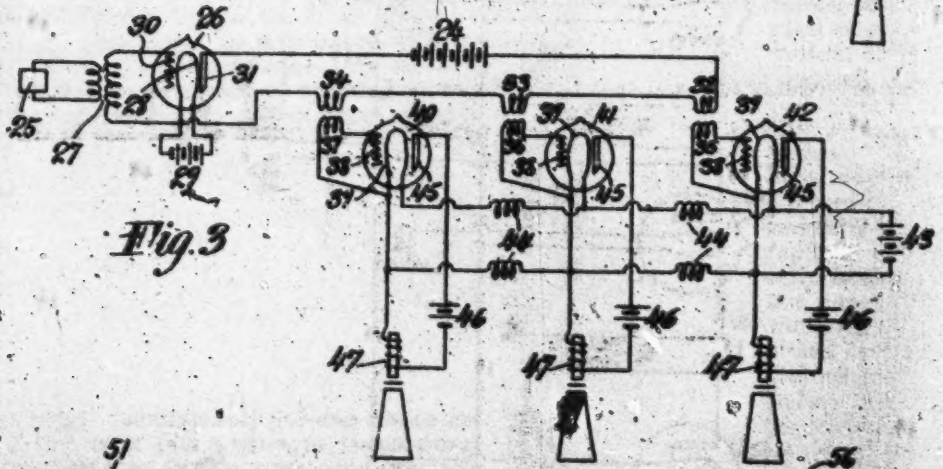
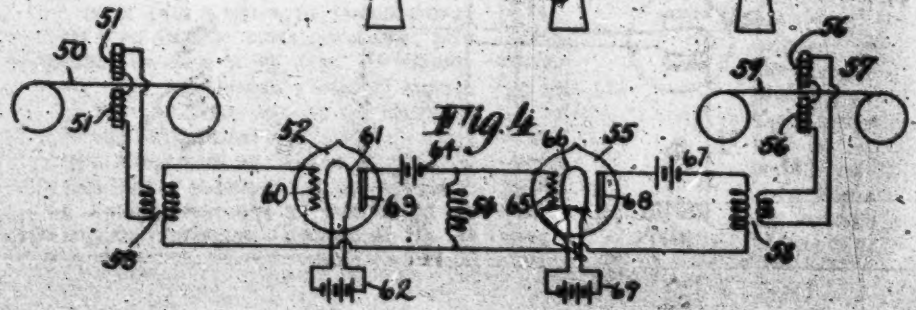


Fig. 4



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1515

L. DE FOREST.

MEANS FOR AMPLIFYING CURRENTS.

APPLICATION FILED JUNE 24, 1913.

1,375,447.

Patented Apr. 19, 1921.

2 SHEETS—SHEET 2.

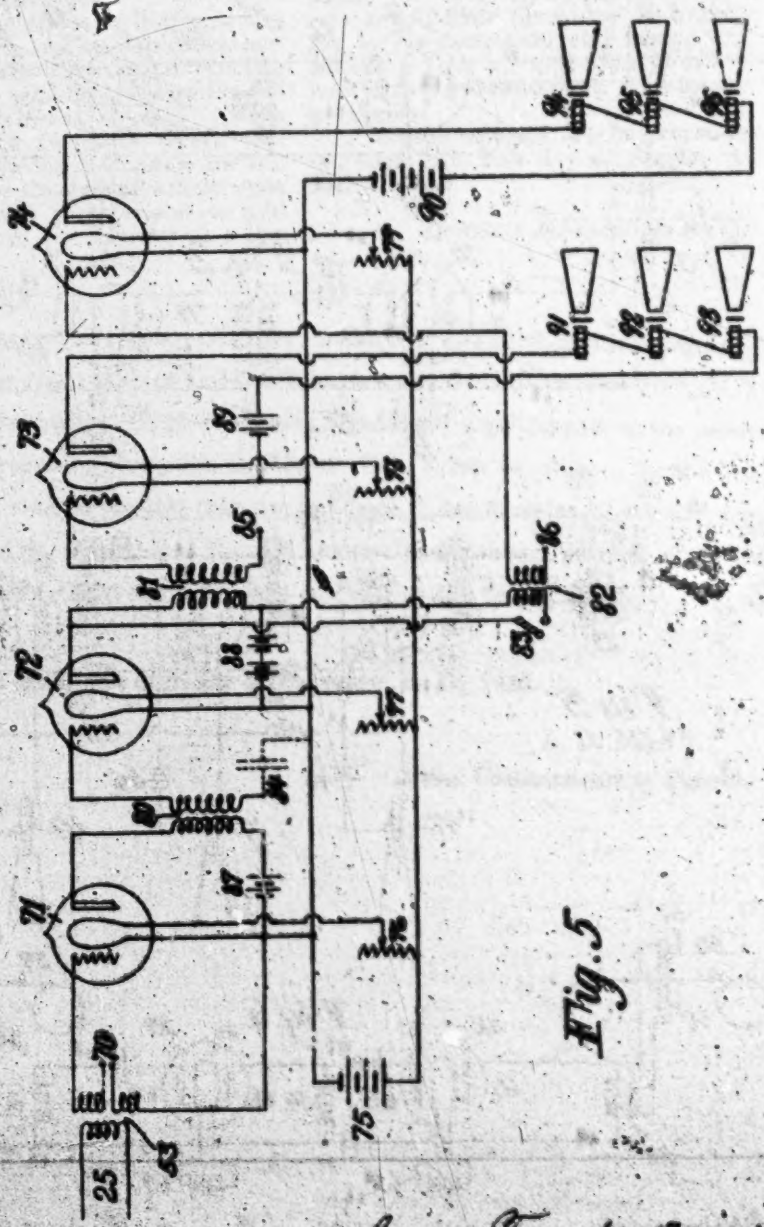


Fig. 5

Witnesses:
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UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF DELAWARE.

MEANS FOR AMPLIFYING CURRENTS.

1,375,447. Specification of Letters Patent. Patented Apr. 19, 1921.

Application filed June 24, 1913. Serial No. 775,319.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Means for Amplifying Currents, of which the following is a full, clear, and exact specification.

This invention relates to the method of and apparatus for reproducing sounds from magnetic sound records, and to the art of reproducing magnetic sound records.

More specifically, my invention contemplates the emission of sounds by apparatus, preferably electrically controlled, from magnetic material, such as a telegraphone wire or strip, or other recording material, and preferably by the use of an audion, or audion amplifier. In accordance with my invention, the telegraphone wire or other magnetic sound record is operated in suitable relationship to one or more magnets controlling an electrical circuit, whereby the magnetic variations corresponding to the recorded sounds, are transformed into electrical "sound" currents, which in turn are transformed into sound by means of a telephone receiver, a "loud-speaking" reproducer, or the like. I also contemplate the reproduction of sounds at a plurality of different locations and more or less remotely situated from the telegraphone wire or other recording material, or other magnetized sound record, and cooperating magnet or magnets. In such form of my invention, I have found it desirable to employ a master audion for electrically controlling individual audions which are connected respectively in or control the various circuits of the various telephone receivers, "loud-speaking" reproducers, or other means for reproducing sounds at the different locations. I also contemplate transferring a record from one telegraphone wire to another, by the use of one or more audions, and cooperating circuits.

Other objects and features of my invention will be understood from the following description, and the accompanying drawings, in which—

Figure 1 represents one form of my apparatus for carrying out my invention, wherein two audions are combined for reproducing sounds recorded on a telegraphone wire;

Fig. 2 is similar to Fig. 1, except that the circuits of the audions are associated by means of a two coil transformer, instead of an auto-transformer;

Fig. 3 shows my method and apparatus for reproducing sounds at a number of different locations from a single telegraphone record;

Fig. 4 shows one form or arrangement for carrying out my method of transferring a sound record from one telegraphone wire to another telegraphone wire; and

Fig. 5 indicates another method and apparatus for carrying out my method of reproducing sounds at a plurality of locations from a single telegraphone wire.

Referring to Figs. 1 and 2, the telegraphone wire 1 is indicated as brought in suitable proximity to the magnets 2, 2. For such purpose, the telegraphone wire may be moved at a suitable speed, such as by winding the wire 1 off of the reel 3 and onto the reel 4 by suitable mechanism, as will be understood. The magnets 2 comprise windings 5, 5, preferably of fine wire, arranged either in series or in parallel in the circuit comprising the conductors 6, 7. The conductor 6 is shown connected to the grid 8 of the audion 9, and the conductor 7 is shown connected to one terminal of the filament 10 of audion 9. The plate or "wing" 11, as indicated in Fig. 1, of audion 9 is connected through the source 12, reactance or bridging coil 13 and conductor 14 to the filament 10. The filament 10 is shown as provided with a control circuit including the source 15. The grid 17 of audion 18 is connected to one terminal of the reactance or auto-transformer 13, the other terminal of the reactance 13 being connected to one terminal of the filament 19 of audion 18, which terminal of the filament 19 is connected to the plate or "wing" 20, of audion 18, through the operating or controlling magnetic coil 22 of the telephone receiver, magnetophone, or "loud-speaking" reproducer and the source 21. The filament 19 of audion 18 is connected to the source 23 in a separate circuit, which will be controlled with respect to voltage and amperage. The sources 15 and 23 are preferably storage batteries, and if desired, the two filaments may be energized by a common source, such as a storage battery. The filaments 10 and 19 may be of any suitable material which be-

comes incandescent at the desired temperature; I prefer to employ filaments of tantalum, ordinarily, since the same gives excellent results under the usual conditions of operation. The plates or "wings" 11, 20 are preferably made of nickel, or the like. In the arrangement shown in Fig. 1, the coil 13 serves as the bridging coil of the two audion circuits, as well as functions as impedance, and may be adjusted for varying impedance.

It will be noted that Fig. 2 shows a two coil transformer 16 instead of the reactance or auto-transformer 13, and the "wing" or plate 11 of audion 9 connected to one terminal of the filament 10 through the primary coil of transformer 16. The grid 17 of audion 18 is shown connected to one terminal of the secondary of the two coil transformer 16, the other terminal of said secondary being connected to one terminal of the filament 19. In the case of either the auto-transformer of Fig. 1, or the two-coil transformer of Fig. 2, the action is the same, the function is the same and the result is the same. In both cases an electrical association is thereby accomplished between the plate element of the one audion and the grid element of the other audion, and each serves to supply reactance.

I prefer, in the arrangement shown in Fig. 2, to employ a one-to-one ratio transformer. The primary, or secondary, or both, may be constructed to be adjustable.

From the above, it will be clear that the magnetic variations recorded in the telegraphone wire 1 will be reproduced electrically in the form of weak undulatory electric currents or impulses in the fine-wire windings 3, 3 of magnets 2, 2 and thus amplified by the audion 9, which electrical amplifications are further amplified by the audion 18, and thereby reproduce sounds in the telephone receiver, megaphone or "loud-speaking" reproducer, corresponding to the original sounds recorded magnetically on the telegraphone wire 1. By suitably controlling the temperature or energization of the filaments 10 and 19, the amplification will be regulated and tonal quality of the sounds controlled.

In Fig. 3, I have illustrated one form of my invention for reproducing sounds at a plurality of points distant from the point of location of a source of weak electric pulsating currents desired to be amplified, such as telegraphone currents, etc. The source of weak electric pulsating currents is schematically indicated at 25, and electrically connected to the master audion 26 through the two-coil transformer 27. The filament 28, preferably of tantalum, is shown energized by the source 29, such as a storage battery. The grid 30 is connected to one terminal of the transformer 27, and the plate or "wing" 31 is connected in circuit with the source 24, and in series with the primaries 32, 33, 34, etc., of the various transformers controlling the various circuits leading to the different points at which the sounds, or other indications, are reproduced. The secondaries 35, 36, 37, etc., are seen respectively connected to the grids 38 and one terminal of the respective filaments 39 of the secondary audions 40, 41, 42, etc. As shown, the filaments 39 may be controlled by a common source, such as the storage battery 43, in which case I prefer to interpose the reactances or choke coils 44 between the respective terminals of the filaments 39, to thereby prevent inter-action between the secondary audions. The plates or "wings" 45 of the auxiliary audions are connected in the respective separate circuits comprising the source 46 and operating or controlling coil 47 of the telephone receiver, "loud-speaking" reproducer, megaphone, etc. In the arrangement shown in Fig. 3, the transformer 27 is preferably a step-up transformer to raise the voltage of the pulsating current derived at 25. The master audion 26 operates to amplify the pulsations, which are transmitted by the transformer 27 to respective primaries 32, 33, 34 of the auxiliary audion circuits; the amplified pulsating currents are further amplified by the separately controlled auxiliary audions to produce the desired intensity of quality of tone or sound emitted by the telephone receiver 47, or the like. The transformers 32, 35,—33, 36,—34, 37,—are preferably one-to-one two-coil transformers. It will be understood that the reactances or choke coils 44 may be of the adjustable type, or may be of the fixed type having a predetermined reactance. It will be clear that the telephone receivers, or the like, may be located at points remote from one another as may be desired. If a high amplification of sound is desired, two or more telephone receivers, or the like, may be connected in series in the same circuit.

In Fig. 4, I illustrate the reproducing of a magnetic sound record on one or more telegraphone wires, to thereby obtain duplicate records. The master or original telegraphone wire 50 is indicated as operated at the desired speed in suitable proximity to the telegraphone magnets 51. The magnets 51 are electrically connected to the audion, as by means of the transformer 53. The reactance 54 is connected across the line between the audion 52 and the auxiliary audion 55, the latter controlling the operating magnets 56 of the telegraphone 57, as by means of the transformer 58. The transformer 53 may be a step-up transformer, and the transformer 58 may be a step-down transformer, although I may make use of a one-to-one two-coil transformer. Thus, the

pulsating currents induced in the magnets 51, 51, will be amplified by the master audion 52 and by the auxiliary audion 55, thereby producing magnetic variations in the field of the magnets 56 of the telegraphone 57 to thereby obtain a suitable magnetic record in the wire 59.

In the particular arrangement shown, the primary of the transformer 53 is connected in series with the fine-wire windings of the magnets 51, 51, and the terminals of the secondary of transformer 53 are respectively connected to the grid 60 of audion 52 and to one terminal of the filament 61, said filament being preferably of tantalum. The source 62 is connected to control the energization of the filament 61. The "wing" or plate 63 of audion 52 is connected through the source 64 to one terminal of the reactance 54, the other terminal of reactance 54 being connected to the terminal of the filament 61 to which one terminal of the secondary of transformer 53 is connected. The grid 65 of audion 55 is connected through the reactance 54 with one terminal of the filament 66 of audion 55, said terminal being also connected to a terminal of the primary of transformer 58. The remaining terminal of primary of transformer 58 is connected to the source 67 and "wing" or plate 68 of audion 55. The filament 66 is shown controlled by a separate source 69; however, if desired, the filaments 61, 66, may be energized by a common source and suitably controlled to obtain the desired joint and individual functions.

It will also be clear that a plurality of telegraphones may be associated with respective auxiliary audions and a master audion, similar to the arrangement shown in Fig. 3, and thereby secure the simultaneous production of a plurality of duplicate magnetic sound records.

In accordance with the arrangement shown in Fig. 5, the weak pulsating currents are transmitted by circuit 25 through the primary of transformer 53, the secondary of which controls one or more master audions 71, 72, which in turn control local circuits, each comprising an auxiliary audion controlling a suitable sound reproducing device. I have found that it is advantageous to form the secondary of transformer 53 of one or more coils electrically interrupted by an open-circuited gap 70. If desired, a condenser may be connected between the terminals of the conductors between which the gap exists; however, under the usual conditions, a condenser is not necessary. The secondary of transformer 53 is connected to the grid element of audion 71 and also to one terminal of the filament of audion 71, the "wing" element of audion 71 being connected through primary of transformer 80 and battery 87 to said terminal of the filament 71. One terminal of secondary of transformer 80 is connected to the grid of audion 72, and the other terminal open-circuited, or, if desired, connected to a condenser 84 and to one terminal of the filament of audion 72. However, I have found it desirable under usual conditions to omit the condenser 84 and the said connection with the filament of audion 72. The auxiliary audions 73, 74, etc., are connected in the respective local circuits and controlled by the master audions 71, 72, preferably through one-to-one two-coil transformers 81, 82, the primaries of which are electrically related in parallel. I prefer to interrupt or open-circuit one of the connections of the primaries of transformers 81, 82, to thereby secure an open-circuited gap, such as that indicated at 83. The source of electrical energy 88, such as a storage battery, is shown connected between the primaries of transformers 81, 82, and one terminal of the filament of audion 72. The battery 88 may be connected between the "wing" element of audion 72 and the primary of the transformers 81, 82. However, the interposition of the battery 88 between the filament and the primary coils of transformers 81, 82, secures superior sensitiveness and more uniform amplification for wide ranges of tone and quality of sounds. Similarly, the connection of source or battery 87 between the primary of transformer 80 and the filament of audion 71 is preferable, under usual conditions of operation, as compared with the interposition of the soice 87 between the primary of transformer 80 and the "wing" element of audion 71.

The secondary of transformer 81 is connected at one end to the grid element of auxiliary audion 73, the other end of secondary 81 being open-circuited at 85. The secondary of transformer 82 is similarly connected at one end to the grid of auxiliary audion 74, and open-circuited at its other end, as indicated at 86. The local circuit of auxiliary audion 73 is shown embodying three electromagnetic sound reproducers 91, 92, 93, the coils of which are connected in series and further connected to the "wing" of audion 73, battery 89 and to one terminal of the filament of audion 73. Similarly, the three electroresponsive sound reproducers 94, 95, 96, arranged in series, are connected to the "wing" element of audion 74, battery 90 and to one terminal of the filament of audion 74.

The respective filaments of master audions 71, 72, and of auxiliary audions 73, 74, are shown energized by a common source of electrical energy 75, such as a storage battery, and respectively controlled by adjustable resistances 76, 77, 78, 79.

It will be clear that but a single local circuit and auxiliary audion amplifier may be used, and actuated and controlled in ac-

cordance with the arrangement indicated in Fig. 5; likewise, three or more local circuits having individual audion amplifiers may be actuated and controlled by transformers arranged in parallel with respect to a main audion. When a plurality of electromagnetic sound reproducers are employed in a local circuit, such reproducers may be positioned at different locations in a room or auditorium, whereby sounds of any desired amplification and of highly satisfactory quality will be reproduced even from so feeble a source as a telegraphone wire. I have secured excellent results in the operation of my arrangement indicated in Fig. 5 without the use of condensers at the open-circuit gaps indicated, although it is feasible to obtain amplified sounds from a telegraphone wire by the use of condensers at said open-circuited gaps. It is advantageous to arrange the grids of the several audions so that the same are not connected to a source of direct current electromotive force, and thereby markedly improve the sensitiveness of the apparatus.

I have discovered that the sensitiveness of the audion is improved by employing a plurality of grids and a plurality of wings, preferably by disposing each grid between a wing and the filament. In the audion 18, see Fig. 1, I have indicated a record grid 17ª disposed between the wing 20 and the filament 19, and a second wing 20ª disposed to one side of the grid 17 and opposite the filament 19, so that the grid 17 is disposed between the wing 20ª and filament 19. In a similar manner, the audions, each or all, as desired, may be provided with a plurality of grids and a plurality of wings, and thereby improve the sensitiveness of operation of the respective arrangements indicated in Figs. 1 to 5, inclusive.

From the above, it will be seen that my method and apparatus contemplates the transmission of relatively weak electric pulsating currents which are amplified by the use of an audion, the amplification of which is controlled independently of the strength, frequency, amplitude, etc., of the pulsating currents. Whereas, I have illustrated particular forms of my apparatus and wherein my method may be carried out, it will be understood that modifications and changes may be made therein without departing from the scope of my invention. The circuit leads from the source of the undulatory electric currents to the first audion may be regarded and termed line wire or receptor connections, and as shown, the current flow therein is unilateral. The audion bulbs, as shown, and as usual, are evacuated vessels in each of which are disposed the filament, the plate or "wing" and the grid. In operation each filament is a cathode and when heated from the source of current in circuit therewith emits negative ions. Each plate or "wing" is an anode and the function of the grids is to form a screen. By impressing undulatory electric currents upon the grids, as, for instance, by connecting the source of undulatory current or the receptor lead thereto, or by connecting electrically the grid or screen of one audion with the plate or anode of another, the potentials of the grids are varied correspondingly to the undulations of the currents so impressed thereon. Since the audion bulbs are evacuated the elements disposed therein are surrounded by a gaseous conducting space, and it is in this space between the cathode and anode elements that the ionization takes place when the cathode or filament is heated thereby forming a conducting path between the cathode and anode and in the local circuit which includes these elements and also a source of external unidirectional electro-motive force such as the batteries 12, 24, 64, 87, 88, 89, 90. These batteries, of course serve to maintain a difference of potential between the anodes and screens or other elements to which their terminals are connected.

In the case of Figs. 3, 4, and 5, the secondaries of transformers 27 and 53 are connected at their respective terminals to the grip or screen and filament or cathode elements, respectively, of their associated audion bulbs through leads or receptor connections in the same way as in the case of the leads 6, 7, of Figs. 1 and 2.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. The combination with a source of weak undulatory current, of an electric circuit including a source of current, means to vary the conductivity of said circuit by and in accordance with said undulatory current, a reactance connected across said circuit, and an audion conductively connected with said circuit.

2. The combination with a source of weak undulatory current, of a vessel having therein an anode and a cathode separated from each other, and a grid or screen, said source of undulatory current being connected to said grid or screen to vary the conductivity of the space between said anode and cathode by and in accordance with said undulatory current, a circuit including therein said anode and cathode, and a source of current, a second vessel containing a cathode an anode and a grid or screen, said circuit being conductively connected to said second grid or screen, a second circuit including therein said second anode and cathode and a separate source of current, and a translating device associated with said second circuit.

3. Apparatus for receiving or relaying

electric signals, having, in combination, an evacuated vessel, a cathode having provision for emitting negative ions, and an anode and its screen inclosed in said vessel, a second evacuated vessel, a second cathode having provision for emitting negative ions, and a second anode, means for conducting signal impulses to the first screen to vary its potential, a local circuit including a source of electromotive force and a conductive electrical connection between the first anode and second screen, and a second circuit having a connection with a signal indicating device and including a source of electromotive force and a connection between the second cathode and second anode.

4. Apparatus for receiving or relaying electric signals, having, in combination, at least one cathode, having provision for emitting negative ions, an anode, a screen in proximity to the anode, a second anode, a second screen in proximity to the second anode, said elements being surrounded by gaseous conducting space, means for conducting the electric signal impulses to the first screen to vary its potential, a local circuit including a source of electromotive force and a conductive electrical connection between the first anode and second screen, and a second circuit connected with a signal indicating device and including a source of electromotive force and a connection between the second anode and a cathode.

5. Apparatus for receiving or relaying electric signals, having, in combination, at least one cathode, a plurality of anodes and screens therefor, said elements being surrounded by gaseous conducting space, a receptor connection to one screen, a conductive electrical connection between another screen and an anode, and a connection from another anode and a cathode to a signal indicating device.

6. Apparatus for receiving or relaying electric signals, having, in combination, an evacuated vessel, a cathode, anode and screen inclosed therein, a second evacuated vessel and a second cathode, anode and screen inclosed therein, a receptor connection to the first screen, a conductive electrical connection between the second screen and first anode, and a connection from the second anode and second cathode to a signal indicating device.

7. Apparatus for receiving or relaying electric signals, having, in combination, at least one cathode having provision for emitting negative ions, an anode, a screen in proximity to the anode, a second anode, a second screen in proximity to the second anode, said elements being surrounded by gaseous conducting space means for varying the potential of the first screen in response to the received signal impulses, means including a conductive electrical connection from the first anode to the second screen and an internal unidirectional source of electromotive force in the connection for maintaining a difference of potential between the second screen and first anode and having provision for causing variations in the potential of the second screen corresponding to variations in the potential of the first screen and means having a connection with a signal indicating device for causing an electric current to flow between the second anode and a cathode.

8. Apparatus for receiving or relaying electric signals, having, in combination, an evacuated vessel, a cathode having provision for emitting negative ions and an anode and its screen inclosed in said vessel, a second evacuated vessel, a second cathode having provision for emitting negative ions and a second anode and its screen inclosed in said second vessel, means for varying the potential of the first screen in response to the received signal impulses, means including an external unidirectional source of electro-motive force for maintaining the second screen at a different potential from the second cathode and having provision for causing variations in the potential of the second screen corresponding to variations in the potential in the first screen, and means having a connection with a signal indicating device for causing an electric current to flow between the second anode and the second cathode.

9. Apparatus for receiving or relaying electric signals having, in combination at least one cathode having provision for emitting negative ions, an anode and its screen, a second anode and its screen, said elements being surrounded by gaseous conducting space, a connection to the first screen for causing variations in its potential corresponding to the received signal impulses, a local circuit including a connection between the first anode and second screen and a source of electromotive force for maintaining a difference of potential between the second screen and first anode, and a connection between the second anode and a cathode including a source of electromotive force.

10. Apparatus for receiving or relaying electric signals, having, in combination, an evacuated vessel, a cathode having provision for emitting negative ions and an anode and its screen inclosed therein, a second evacuated vessel, and a second cathode having provision for emitting negative ions and an anode and its screen inclosed therein, a connection to the first screen for causing variations in its potential corresponding to the received signal impulses, a local circuit including a connection between the first anode and second screen and a source of electromotive force for maintaining a second screen at a potential negative with respect to the

second cathode, and a connection between the second anode and second cathode including a source of electromotive force.

11. Apparatus for receiving or relaying electric signals, having in combination, at least one cathode having provision for emitting negative ions, a plurality of anodes and their screens, a receiving connection to one screen, a conductive electrical connection between another screen and the anode which is adjacent the first screen, and a connection from another anode and a cathode to a signal indicating device.

12. Apparatus for receiving or relaying electric signals, having, in combination, an evacuated vessel, a cathode having provision for emitting negative ions, and an anode and its screen in proximity to the cathode inclosed within said vessel, means for maintaining the screen at a negative potential with respect to the cathode by a current supplied through a similar evacuated vessel and for superimposing on said negative potential variations in potential corresponding to the signal impulses and means including a connection to a signal indicating device for causing an electric current to flow between the cathode and anode.

13. Apparatus for receiving or relaying electric signals, having, in combination an evacuated vessel, a cathode having provision for emitting negative ions and an anode and its screen adjacent the cathode inclosed within said vessel, means tending to cause a current to flow between the anode and the cathode, means including a source of electromotive force and a partly gaseous path for normally maintaining the screen at a potential negative with respect to the cathode, and means for causing variations in the potential of the screen corresponding to the signal impulses.

14. Apparatus for receiving or relaying electric signals, having, in combination, an evacuated vessel, a cathode having provisions for emitting negative ions and an anode and its screen inclosed in said vessel, a second evacuated vessel, a second cathode having provision for emitting negative ions and a second anode and its screen inclosed in the second vessel, means for causing variations in the potential of the first screen corresponding to the signal impulses, a circuit across the evacuated space from the first cathode to the first anode, along a wire connection to the second screen, across the evacuated space from the second screen to an adjacent electrode and back along a wire connection to the first cathode, such circuit including a source of electromotive force tending to cause a negative current to flow from the first cathode to the first anode, and a second circuit across the evacuated space from the second cathode to the second anode, said circuit including a connection to a signal indicating device and a source of electromotive force for causing a negative current to flow from the second cathode to the second anode.

15. Apparatus for receiving or relaying electric signals, having, in combination, a local circuit including a source of electromotive force, an amplifier including a plurality of electrodes surrounded by a gaseous conductor, and connected with the local circuit and operating to produce impulses in the local circuit corresponding to but of greater intensity than the received signal impulses, a second circuit including a source of electromotive force and a connection with a signal detecting device, and a second amplifier including a plurality of electrodes surrounded by a gaseous conductor, said second amplifier being conductively electrically connected with both circuits and operating to amplify the current impulses in the second circuit corresponding to but of greater intensity than the impulses in the first local circuit.

16. Apparatus for receiving or relaying electric signals, having, in combination, a local circuit including a source of electromotive force, an amplifier including a cathode, anode and screen surrounded by a gaseous conductor, said amplifier having a connection from its anode and cathode to the local circuit and a connection for leading the received impulses to its screen and operating to produce impulses in the local circuit corresponding to but of greater intensity than the received signal impulses, a second circuit including a source of electromotive force and a connection to a signal detecting device, and a second amplifier including a cathode, anode and its screen surrounded by a gaseous conductor and having its cathode and anode connected to the second local circuit and its screen conductively electrically connected to the first local circuit and operating to amplify the impulses in the first local circuit to produce impulses in the second local circuit corresponding to but of greater intensity than in the first local circuit.

17. The combination, with the line wire, of apparatus for receiving or relaying electric signals transmitted over wires, comprising an evacuated vessel, a cathode, anode and its screen inclosed therein, and a unilateral connection between the apparatus and the line wire.

18. The combination, with the line wire, of apparatus for receiving or relaying electric signals transmitted over wires, comprising a cathode having provision for emitting negative ions, an anode, and its screen in proximity to the cathode, said elements being surrounded by a gaseous conductor, a connection between the cathode and anode including a source of electromotive force,

and a unilateral connection between the apparatus and the line wire consisting of a receptor lead connected to the screen.

19. The combination, with the line wire, of apparatus for receiving or relaying electric signals transmitted over wires, comprising an evacuated vessel, a cathode, anode and screen inclosed therein, a connection between the cathode and anode including a source of electromotive force, a transformer having its primary in series with the line wire, and a unilateral connection between the transformer and the apparatus consisting of a receptor connection from one terminal of the transformer secondary to the screen, the other terminal of the secondary being unconnected with the apparatus.

20. The combination with a magnetic sound record, means to generate an alternating electric current by and in accordance with said record, an audion having a filament, an anode and a grid disposed therein, a circuit connection to impress said alternating current upon said grid, an energizing circuit for the filament, a second audion having a filament, an anode and a grid, a circuit connection including the anode and filament of the first audion conductively connected to the grid and filament of the second audion, and a source of current, and a local circuit including the anode and filament of the second audion and a source of current.

21. The combination with a source of current, of a plurality of audions conductively connected in series, the input circuit of the first of said audions being associated with said source of current, and an independent source of current connected to the output electrode of each of said audions.

22. The combination with a source of current, of a series of audions, the input electrode of the first of said audions in the series being associated with said source of current, the output electrode of the first audion of the series being conductively connected to the input electrode of the next audion of the series, and a separate source of current for the output electrode of each of said audions.

23. The combination with a source of current, of a series of audions, the input electrode of the first of said audions in the series being associated with said source of current, the output electrode of the first audion of the series being conductively connected to the input electrode of the next audion of the series, a separate source of current for the output electrode of each of said audions, and a signal indicating device associated with the output electrode of the last audion of the series.

24. An electrical amplifying system comprising a vacuum tube device having anode and cathode electrodes, means for supplying a space current between said electrodes, means for controlling said space current in accordance with an impulse to be transmitted, an impedance in circuit with said electrodes, and an amplifier conductively connected to said impedance.

25. An electrical amplifying system comprising a vacuum tube device having an anode and a cathode, an impedance, means for supplying current through said impedance and between said electrodes, means for controlling said current in accordance with an impulse to be transmitted, an amplifier having an input circuit and an output circuit, said input circuit being conductively connected and responsive to the potential variations across said impedance, and a receiving device connected to said output circuit.

26. Means for amplifying the alternating current component of a unidirectional current comprising an electron discharge device having plate and grid circuits, one of said circuits containing a source of current to be amplified, and an impedance conductively included in the circuit of the source of current to be amplified and included in the grid circuit through which the current to be amplified is caused to flow.

27. Means for amplifying the alternating current component of a unidirectional current comprising an electron discharge device having plate and grid circuits, one of said circuits containing a source of current to be amplified, and a reactance conductively included in the circuit of the source of current to be amplified and included in the grid circuit through which the current to be amplified is caused to flow.

28. An electrical amplifying system comprising a vacuum tube device having anode and cathode electrodes, means for supplying a space current between said electrodes, means for controlling said space current in accordance with an impulse to be transmitted, a reactance in circuit with said electrodes, and an amplifier conductively connected to said reactance.

29. A multi-stage amplifier comprising a plurality of vacuum tube devices each having an anode, a cathode and a control circuit, another circuit comprising a source of current and a reactance connected to the anode and cathode of one of said devices, and a conductive connection from said reactance to the control circuit of another of said devices.

In testimony whereof I affix my signature, in presence of two witnesses.

LEE DE FOREST.

Witnesses:
HENRY J. LOCKE,
GEO. N. KING.

1523

L. DE FOREST.
AUDION CIRCUIT.
APPLICATION FILED APR. 27, 1920.

1,377,405. Patented May 10, 1921.

Fig. 1.

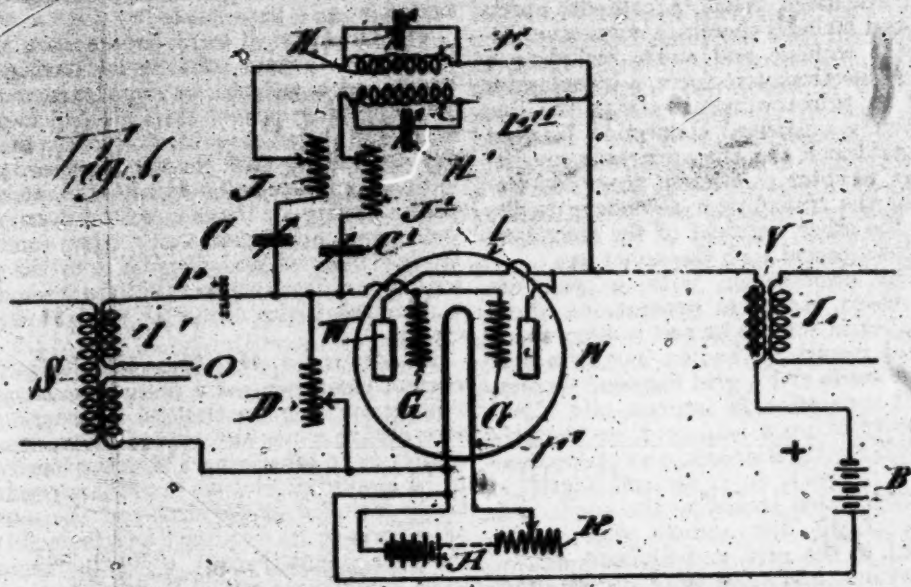
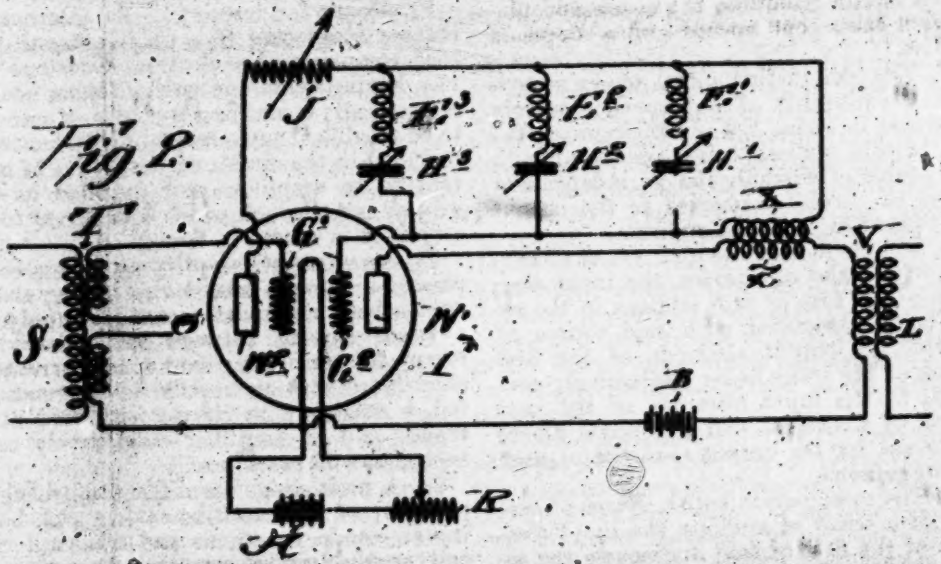


Fig. 2.



INVENTOR
Lee de Forest
BY his ATTORNEY Samuel E. Darby

UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR TO DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

AUDION-CIRCUIT.

1,377,405. Specification of Letters Patent. Patented May 10, 1921.

Original application filed April 9, 1915, Serial No. 20,173. Divided and this application filed April 27, 1920. Serial No. 377,251.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, residing at New York, county and State of New York, have made a certain new and useful Invention in Audion-Circuits, of which the following is a specification.

This invention relates to audion circuits, and is directed to subject matter divided from my co-pending application, Serial Number 20173, filed April 9, 1915, for selective audion amplifier.

The object of the invention is to provide an audion circuit which is simple and particularly adapted for amplification usage of the audion where the same is used as a relay as one illustration for either wire or wireless purposes.

It has been found by experiment that relays of the audion type become paralyzed when certain conditions in the normal operation exist. For example, where the device is used as an amplifier or relay with the current to be relayed and amplified received through an input circuit and the amplified current delivered by an output circuit, if the incoming current is excessive too large a charge upon the grid electrode of the audion causes the same to paralyze. Similarly, it frequently happens that a sudden signal impulse will effect the same result, namely, the paralysis of the audion. Also, if the plate current is excessive the effect of the paralysis is likewise produced. And if a critical adjustment of the plate and filament current sources is secured the normal incoming signal is apt to produce the paralyzed condition of the audion. So it will be apparent that while the effect is the same, that is, the audion becomes paralyzed, the causes of this condition of the audion may be any one of a number.

Where a perfect vacuum has not been obtained in the bulb this paralyzed condition of the audion is frequently evidenced by a blue glow or haze although the paralyzed condition may frequently occur without any such visual evidence thereof, and is detected by the operator who at once generally knows that when the audion is not properly functioning it has become paralyzed.

The special purpose of my present invention is to provide means for effectively preventing and overcoming this paralyzed condition of the audion, and while I have shown and will now describe my invention as applied to an audion with all of the cathode and anode electrodes inclosed therein and as used as an amplifier or relay, I do not desire to be limited or restricted either to this construction or particular application of an audion.

Referring to the drawings,—

I show in Figure 1 one audion circuit arrangement embodying my invention, and which is a substantial duplication of Fig. 1, of my co-pending application above identified.

Fig. 2 shows a similar but slightly modified arrangement.

The same part is designated by the same reference numeral wherever it occurs throughout the several views.

Referring to Fig. 1, I show my present invention applied to a selective amplifier system of the audion type wherein the audion will perform its amplifying function selectively. In other words, incoming currents or currents of certain frequencies received by the audion will be amplified to a greater degree than currents of other frequencies, and especially currents of lower frequencies. In addition thereto, the principle of selective amplification can be emphasized as much as desired or necessary so that, if desired, the normal voice currents before going in on a telephone line, for example, can first be distorted and the higher harmonics thereof made of greater amplitudes so that after these latter currents are reduced in amplitude by the distributed capacity of the telephone line, the composite current will arrive at the distant receiving station in its normal or original form. This feature of selective amplification forms the subject matter of my application, Se-

rial No. 9,172 above identified, and does not form the subject matter of the present invention except in that the present invention is disclosed therein.

Reference character 1 designates an exhausted audion bulb, in this instance of the usual well known double plate and double grid structure both located within the bulb. It is apparent, however, that I do not desire to be limited with respect to the particular construction of the audion, or whether or not the electrodes are all located within the bulb or exterior thereof, as it is well known that audions vary somewhat in their construction and in the number of electrodes employed therein or therewith. As is customary, however, I have shown a filament electrode F which is heated from the current source A and controlled by the variable resistance R in the usual well known manner. The grid elements or input electrodes G, G, are preferably arranged on either side of the filament F and are connected in parallel. The wing or plate electrodes W, W, are also arranged on respectively opposite sides of the filament F and at a different distance therefrom relative to the grid electrodes, G, G. The incoming current to be amplified is led from the line to the primary coil S of a transformer T, preferably a step-up transformer. While I am not to be limited to the specific arrangement shown, I prefer to have the secondary coil of the transformer T wound in two parts disconnected from each other as shown at [illegible] the parts thereof possessing a large capacity relative to each other. One end of one winding of the secondary coil of the transformer T is connected directly to the filament F of the audion 1, while one end of the other coil is connected to the grids G, G, of the audion 1. If desired, in the transformer and grid circuit, a condenser may be inserted, as shown in dotted lines at P. The plate or wing electrodes W, W, are connected through an inductance coil of a transformer V to one terminal, preferably the positive terminal of a source of current such as a battery B, the current, preferably the negative, terminal of which is connected to the filament F of the audion 1. The outgoing circuit I, is connected to the secondary of the transformer V. An oscillating circuit consisting of the inductance E and capacity H in parallel thereto is connected by one terminal to the wing or plate electrodes W, W, and the other terminal to the grid electrodes G, G. If desired, and as shown, a capacity preferably in the form of a variable condenser C, may be inserted in this circuit. In accordance with my invention I insert a resistance J in this circuit, preferably in the lead to the grid electrodes G, G, and preferably, as shown, to make the resistance variable. By making the resistance variable I utilize the same in addition to the uses hereinbefore set forth as a damping resistance to reduce the amplitude of the potential surges delivered from the oscillating circuit H, E, to the grid electrodes, as above described.

The natural period of vibration of this oscillating or parasitic circuit depends to a great extent upon the amount of inductance of the coil E and the amount of the capacity of the condenser H. This frequency also depends upon the constants of the audion itself, the brightness of the filament F, the applied potential from the battery B, the amount of resistance J, and the amount of resistance D which forms a leak path between the grids G, G, and filament F, and is likewise made variable.

In addition to the first oscillating or parasitic circuit, if desired, a second similar circuit comprising elements C', J', E', H', identical with the corresponding elements of the first circuit may be connected between the grid and plate electrodes, but the oscillating circuit E', H', should be tuned to a different frequency or natural rate of oscillation than that of the first oscillating circuit. Similarly, a number of oscillating circuits, each tuned to a different frequency, can be connected to the audion.

It is not necessary, however, to connect such a parasitic or reinforcing circuit to the audion for each different frequency it is desired to amplify. I have found that one such circuit, the natural fundamental frequency of which may be such as to cause it to tend to oscillate approximately 1500 times per second, will cause incoming currents having frequencies considerably higher than 1500 to be amplified to almost the same degree, while at the same time not permitting currents having considerably lower frequencies to be thus auto-amplified. I have found that two such reinforcing circuits, the natural period of one of which is such as would cause the audion to deliver a sustained note of a frequency of about 1800 per second, if free to oscillate; and the natural period of the other of which is such as would cause the audion to deliver, if free to oscillate, a sustained note of about 2500 per second, will reinforce currents of all frequencies between 1200 and 3000 per second. It is therefore possible to arrange a single audion with reinforcing circuits to so selectivaly amplify voice currents that all the higher harmonics are amplified over those of the lower or fundamental frequencies.

The principles involved in enabling an audion to amplify different frequency currents unequally is set forth in my co-pending application above identified, from which the subject matter of this present application has been divided, and while I have gone rather fully into the description of

selective amplifier circuit it should be remembered that my present invention is directed solely to the resistance leak path between the elements of the audion, and the full description of the selective amplifier has been given to enable a clear understanding of one application of my present invention to a specific system.

In Fig. 2 I have shown another circuit arrangement wherein the incoming currents are conducted to one of the grid electrodes as G'. One of the wing or plate electrodes W' is connected to the outgoing line in the usual manner. The oscillating or "reinforcing" circuits are connected to the other electrodes W^2, G^2, of the audion bulb 1. Each of the oscillating circuits contains a common inductance X associated with the coil Z in the output circuit. The individual inductances E^1, E^2, E^3, etc., each in series with the capacity H^1, H^2, H^3, etc., respectively, determine the period of the reinforcing circuits, of which in this figure I have shown three. The effect of these reflection circuits associated with the output circuit is to impart to the audion the tendency to disproportionately amplify currents having frequencies generally approximately those of the three reinforcing circuits. In this arrangement the resistance J is inserted in the audion path of these circuits to prevent the audion from singing, and to afford a high resistance leak path as hereinbefore described.

From the foregoing it will be apparent that while it is preferable to connect the high resistance between the two cold electrodes, especially where the device is to operate as a relay, as shown in Fig. 2, the high resistance path may equally well be connected between either of the cold electrodes and the hot electrode, in the latter case preferably between the grid and filament.

Having now set forth the objects and nature of my invention, and having shown and described a construction embodying the principles thereof, what I claim as new and useful and of my own invention and desire to secure by Letters Patent is,—

1. An electric relay comprising an incoming circuit, an outgoing circuit including a gaseous conductor, forming a part of each of said circuits, and a conductive leakage path connected to two points in said gaseous conductor.

2. An electric relay comprising an incoming circuit, an outgoing circuit including a gaseous conductor forming a part of each of said circuits, and a high resistance conductive leakage path connected to two points in said gaseous conductor.

3. An electric relay comprising an evacuated vessel, a heated member, a conducting member and a conducting plate sealed therein, an incoming circuit connected across said heated member, and said conducting member, an outgoing circuit connected across said heated member, and said conducting plate, and an additional metallic circuit connecting said conducting member and said plate.

4. An electric relay comprising an evacuated vessel, an incoming circuit, an outgoing circuit, a cathode common to said circuits and anodes individual to said circuits sealed in said vessel, and a shunt circuit including a high resistance connecting said anodes.

5. An electric relay comprising an evacuated vessel, a heated electrode, a grid shaped member and a plate sealed therein, an incoming circuit including said heated electrode, a condenser and said grid member; an outgoing circuit including said heated electrode, a source of potential and said plate; and a shunt circuit including said grid member and said plate.

6. In an electric relay, the combination with an audion, of a circuit including a resistance in shunt of two of the elements of said audion.

7. An electric relay, comprising an incoming and an outgoing circuit, a gaseous conductor interposed between such circuits, and a conductive shunt circuit connected around said gaseous conductor.

8. An electric relay, an incoming circuit, an outgoing circuit including a gaseous conductor forming a part of each of said circuits and a conductive leakage path connected in parallel with a part of said gaseous conductor.

9. An electric relay comprising an evacuated vessel, a heated member, a conducting member and a conducting plate sealed therein, and a conductive circuit connected to said conducting member and said plate.

10. The combination with an evacuated vessel having associated therewith a hot and two cold electrodes, each of said cold electrodes being located at a relatively different distance from said hot electrode, electrical circuits connecting said electrodes, and a conductive leakage path connected to two of said electrodes.

11. The combination with an evacuated vessel having associated therewith a hot and two cold electrodes, each of said cold electrodes being located at a relatively different distance from said hot electrode, electrical circuits connecting said electrodes, and a high resistance conductive leakage path connected to two of said electrodes.

12. The combination with an evacuated vessel having associated therewith a hot and two cold electrodes, each of said cold electrodes being located at a relatively different distance from said hot electrode, electrical

circuits connecting said electrodes, and a metallic resistance permanently connected between two of said electrodes.

13. The combination with an evacuated vessel having associated therewith filament, grid and plate electrodes, circuits connecting said electrodes, and a conductive leakage path connected between the grid and plate electrodes independent of the evacuated space between said grid and plate electrodes.

14. The combination with an evacuated vessel having associated therewith filament, grid and plate electrodes, circuits connecting said electrodes, and a high resistance leakage path connected between the grid and plate electrodes independent of the evacuated space between said grid and plate electrodes.

15. The combination with an evacuated vessel having associated therewith filament, grid and plate electrodes, circuits connecting said electrodes, and a metallic high resistance path permanently connected between the grid and plate electrodes.

16. The combination with an evacuated vessel having associated therewith filament, grid and plate electrodes, circuits connecting said electrodes, and an aperiodic circuit connected between two of said electrodes.

17. The combination with an evacuated vessel having associated therewith filament, grid and plate electrodes, circuits connecting said electrodes, and an aperiodic circuit connected between the grid and plate electrodes.

In testimony whereof I have hereunto set my hand on this 21st day of April, A. D. 1920.

LEE DE FOREST.

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PAGE

1528

R. A. WEAGANT.

MEANS FOR GENERATING ELECTRICAL OSCILLATIONS.

APPLICATION FILED APR. 9, 1914.

1,384,108. Patented July 12, 1921

Fig. 1.

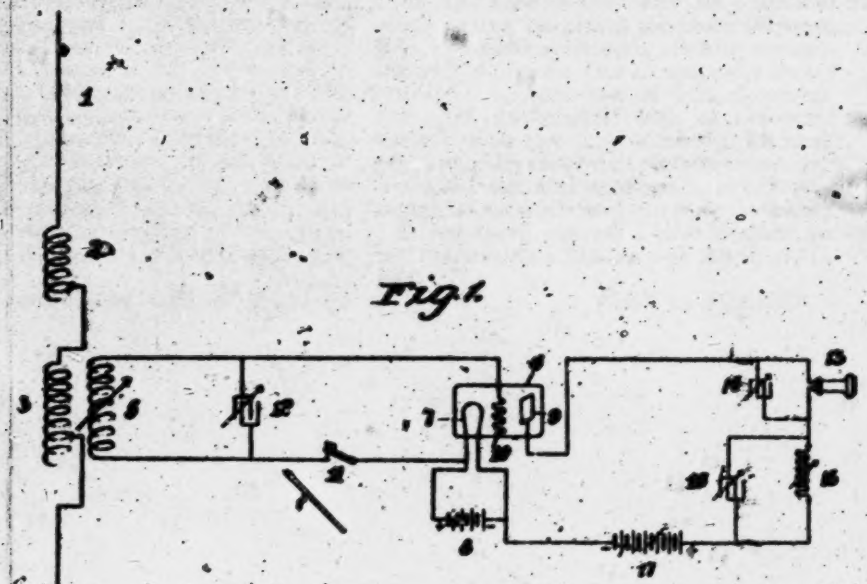
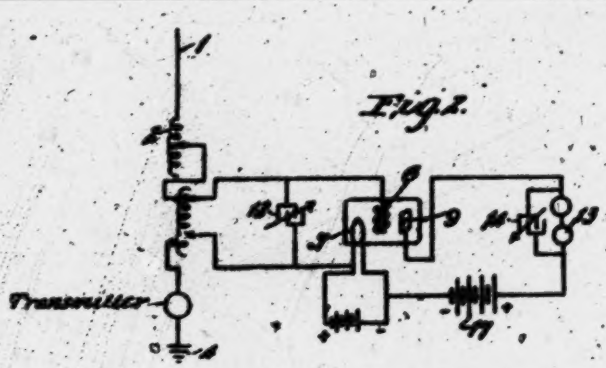


Fig. 2.



Witnesses:
E. J. Ashley
M. A. McKnight

Inventor:
ROY A. WEAGANT
By his Attorneys
Chapin Bros. & Co.

UNITED STATES PATENT OFFICE.

ROY A. WEAGANT, OF ROSELLE PARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE.

MEANS FOR GENERATING ELECTRICAL OSCILLATIONS.

1,384,108. Specification of Letters Patent. Patented July 12, 1921.

Application filed April 9, 1914. Serial No. 830,884.

To all whom it may concern:

Be it known that I, ROY A. WEAGANT, a citizen of the United States, and a resident of Roselle Park, in the county of Union, State of New Jersey, have invented certain new and useful Improvements in Means for Generating Electrical Oscillations, of which the following is a specification.

The object of my invention is to produce means for generating electrical oscillations by means of a gaseous conducting medium which shall be small, simple and relatively cheap, shall have no moving parts, shall have reliable adjustments and be adapted to work continuously without attention.

These oscillations are capable of a variety of uses. They may be used for wireless or wire telegraphy or telephony, or any other purpose for which such oscillations may be found useful.

In the drawing accompanying this specification I have illustrated one of the many applications of my invention, the illustration being in connection with wireless telegraphy. This illustration is intended primarily to show an operative structure in which my new means of obtaining electrical oscillations are used, and is not to be understood as showing the only form or manner in which my invention may be used.

Figure 1 shows diagrammatically one embodiment of the complete system;

Fig. 2 shows a system of the same general kind in which some of the details have been varied.

Referring to the drawings and particularly to Fig. 1, these show my invention as applied to the transmitting station of a wireless telegraph system, the aerial is shown at 1, the aerial tuning inductance at 2, the primary of a transformer at 3, the aerial being earthed at 4, as usual, connected to the aerial by means of the secondary 5 of a transformer, or any equivalent means, is a circuit which includes a vessel 6. This vessel 6 may be a sealed vessel preferably of glass or similar material inclosing a plurality of conducting elements or electrodes separated by a conducting gaseous medium. Rarefied air or any other suitable medium may be used, such for instance as mercury vapor. The use of these substances involves no change in the apparatus. In the particular embodiment shown the vessel includes a hot element 7 in the form of a filament, which is heated by any convenient source of heat such as a battery or other source of current 8, a cold element 9 in the form of a plate, and a second cold element 10, which is preferably in the form of a grid or spiral of wire. The filament is preferably formed of a substance adapted to give up a copious supply of corpuscles when heated to incandescence. The cold elements 9 and 10 may be formed of nickel or any other suitable material and are not necessarily of the particular form shown.

The terminals of the secondary 5 of the transformer are preferably connected one to the grid element 10 and the other, through a key 11, to the hot element 7. Across the terminals of secondary 5 a variable condenser 12 may be connected so that a resonant circuit may be established through the condenser and secondary 5 of the transformer.

Attached to two of the conducting elements, preferably the hot element 7 and the cold element 9, is a local circuit, which may for convenience be called the energizing circuit. A telephone or other indicating instrument 13 which is used to ascertain the correctness of the adjustments may be included in the energizing circuit. This telephone is preferably shunted by a condenser 14 which provides a convenient adjustment. In series with the telephone a relatively high variable resistance 15 may be placed, which resistance is shunted by a variable condenser 16. Although I prefer to include resistance 15 in the energizing circuit, it is not necessary to the operation of my device. In series with the resistance is a relatively powerful battery or other source of electric current 17, which furnishes the energy for the production of oscillations in vessel 6.

As thus connected, my device generates electric oscillation which are impressed upon the aerial through the inductive coupling, 3, 5 upon the closing of the key 11, thus producing signals.

In operating my device the hot member 7 is first brought to an incandescent condition. The voltage of the battery 17 is then adjusted until a high note is heard in the telephone 13, after which condenser 14, or condenser 16, or both, are varied until the note is no longer heard in the telephone. A faint blue glow is then usually observable in the vessel, which I believe to indicate that

ionization of the gas contained therein has set in. The inductance 5 and the condenser 12 are then adjusted until the values are such as to produce the desired wave length. The aerial circuit 1, 2, 3, 4, is then adjusted until it is in tune with the oscillations being produced by the generating means. The signals are produced by opening and closing key 11 or in any other well known manner, after the proper adjustments of the generating means have been obtained.

An important advantage of my device consists in the fact that in its operation a very small variation of the current passing through the hot element 7 creates a large variation of the current delivered to the aerial. In a similar manner a small potential variation between the plate element 9 and the hot element 7 also causes a very large variation of the current delivered to the aerial. Thus, these large currents are made subject to the control of very small quantities, which may easily be controlled by apparatus unable to control large quantities of current or voltage as, for instance, a telephone or similar device.

It is obvious that the specific arrangement illustrated, wherein my improved means for generating electrical oscillations is used, may be varied in a number of ways without departing from the spirit of my invention. For instance, when used for wireless telegraphy, an auto-transformer may be used instead of an inductive coupling, or other connections to the aerial may be made use of. Also, instead of using the key 11 a continuous emission of waves may be produced and their wave lengths varied by varying the inductance of the aerial in order to produce a signal. When used in wire telegraphy or telephony, any desired wire circuit may be substituted for the aerial, and when used in wireless, or wire, telephony a telephone transmitter and receiver may be introduced in one of the circuits at a convenient point. Examples of such modifications are illustrated in Fig. 2, which shows the circuits adapted to be used either for receiving or transmitting in a wireless telephone system. I have not described the exact method of making all of these modifications and applications of my device and the many others which might be made, since they can be readily made in manners which will be understood by those skilled in the art.

What I claim is:

1. An oscillation generator system including a sealed evacuated vessel in which oscillations are generated, said vessel including three electrodes, means for maintaining current through one of said electrodes, two circuits exterior to said vessel and connected each between two of said electrodes, one of said circuits containing an electrode not in the other circuit and including a source of continuous current causing the production of oscillations in said vessel, and one of said circuits containing sufficient ohmic resistance to materially and favorably affect the production of oscillations.

2. Means for generating electrical oscillations comprising an oscillation generating circuit, an energizing circuit comprising a battery and a non-inductive resistance, and means for adjusting said resistance, the said circuits being connected through a sealed vessel inclosing a plurality of elements separated by a conducting gaseous medium.

3. Means for generating electrical oscillations comprising an oscillation generating circuit, an energizing circuit containing a source of energy in series with a non-inductive resistance, associated with the generating circuits through a sealed vessel inclosing a plurality of elements separated by a conducting gaseous medium, and variable means in said energizing circuit for controlling the flow of current therein.

4. An oscillation generator system including a vacuum valve having a plate, grid and filament elements, and circuit connections therefor, and a non-inductive resistance connected between the filament and one of the other elements, and an output circuit for the generated oscillations.

5. Means for generating electrical oscillations comprising an oscillation generating circuit tuned to the periodicity of the oscillations it is desired to generate, an energizing circuit containing a source of energy in series with a non-inductive resistance shunted by a condenser, associated with the generating circuit through a sealed vessel inclosing a plurality of elements, and variable means in said energizing circuit for controlling the rate of flow of the current therein.

6. In an oscillation generator system, the combination with a normally oscillating audion having three terminal elements and a non-inductive resistance connected between two of the elements of the audion.

7. In an oscillation generator system, the combination with a normally oscillating audion having three electrode members and a non-inductive resistance connected between two of the electrode members.

In testimony whereof I have hereunto signed my name in the presence of two witnesses this 8th day of April, 1914.

ROY A. WEAGANT.

Witnesses:
WALTER R. JOHNS,
WM. M. EARL.

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E. H. COLPITTS AND H. DE F. ARNOLD.

TRANSMISSION OF INTELLIGENCE.

APPLICATION FILED SEPT. 3, 1915. RENEWED JAN. 13, 1921.

1,388,450. Patented Aug. 23, 1921.

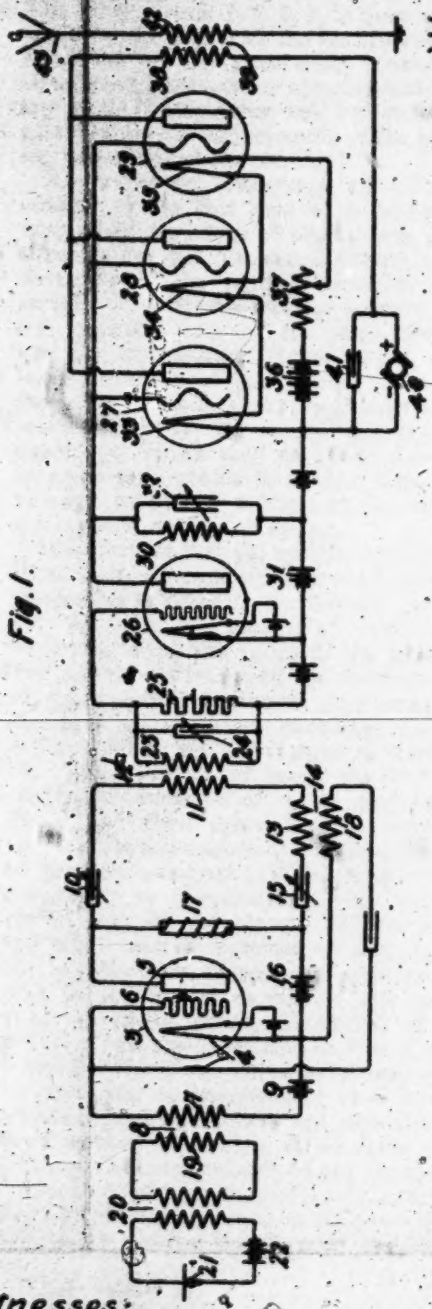


Fig. 1.

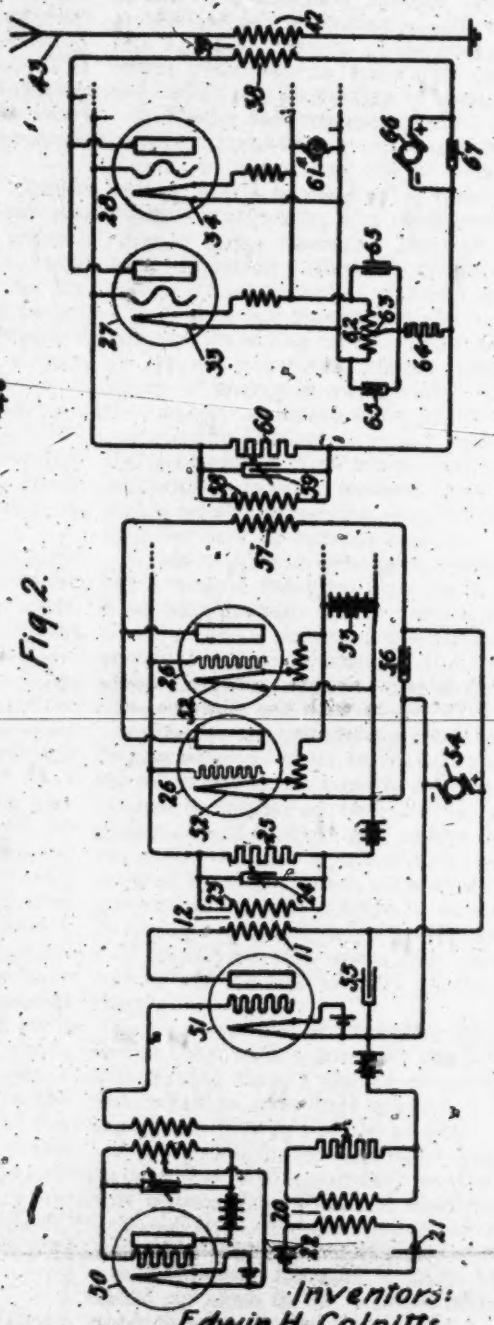


Fig. 2.

Witnesses:
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O. E. Rasmussen

Inventors:
Edwin H. Colpitts.
Harold D. Arnold
by S. C. Hanner. Atty

UNITED STATES PATENT OFFICE.

EDWIN H. COLPITTS, OF EAST ORANGE, AND HAROLD DE FOREST ARNOLD, OF MAPLEWOOD, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

TRANSMISSION OF INTELLIGENCE.

1,388,450. Specification of Letters Patent. Patented Aug. 23, 1921.

Application filed September 3, 1915, Serial No. 48,739. Renewed January 13, 1921. Serial No. 437,128.

To all whom it may concern:

Be it known that we, EDWIN H. COLPITTS and HAROLD DE FOREST ARNOLD, citizens of the United States, residing respectively at East Orange, in the county of Essex and State of New Jersey, and Maplewood, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in the Transmission of Intelligence, of which the following is a full, clear, concise, and exact description.

This invention relates to the transmission of intelligence, and more particularly to systems in which sustained oscillations of high frequency are employed as carrier waves, and in which the amplitude of such oscillations is made to vary in accordance with variations in message waves of comparatively low frequency.

Its object is the production of high frequency waves which are are accurately modulated in accordance with the message wave and of sufficient power for effective long distance communication.

To these ends the invention provides for the generation of carrier waves of the required high frequency, but of a power value comparable with that of the message impulses, as distinguished from that ultimately required for effective transmission. It further provides for modulating or changing the amplitude of these oscillations of low power in accordance with the form of the message wave and for amplifying the power value of the modulated high frequency oscillations to a degree sufficient for long range communication.

The arrangement of this invention makes possible to use, as the low frequency message source, a telephone transmitter or other device capable of handling only a small amount of energy, whereas in previous systems it has been assumed that for effective long range communication it was essential that the low frequency-message source should be one capable of handling an amount of power comparable with that necessary for radiation.

In other words, the power value of the generated oscillations is chosen with reference to the power delivered by the primary modulating source rather than with reference to the amount of power necessary for radiation.

The invention will be more clearly understood by reference to the accompanying drawing, in which Figure 1 represents the system of this invention arranged for radiotelephonic transmission; and Fig. 2 shows an improvement on the system of Fig. 1, incorporating certain specific modifications which are the inventions of others and which have been made the subject matter of other patent applications.

Referring to Fig. 1, 3 is a thermionic amplifier of the well known type, having a filamentary cathode 4, an anode 5, and a grid or input electrode 6. The input circuit of this amplifier includes the cathode 4, the electrode 6, secondary winding 7 of transformer 8, and battery 9 whose function it is to give the electrode 6 a negative potential with respect to cathode 4. The output circuit of the amplifier 3 includes the anode 5, condenser 10, primary winding 11 of transformer 12, winding 13 of transformer 14, condenser 15, battery 16 and the cathode 4. An impedance coil 17 is inserted, as shown, to provide a direct current path for space current supplied to the amplifier 3 by the battery 16.

Secondary winding 18 of transformer 14 is bridged across the cathode 4 and electrode 6, as shown, and serves to feed back, into the input circuit of the amplifier, currents generated in the output circuit, thereby causing the amplifier 3 to function as a generator of high frequency oscillations, the periodicity of which is determined by the adjustment of condensers 10 and 15. For a more complete understanding of this action, reference may be had to the Colpitts Patent 1,137,384.

Primary winding 19 of transformer 8 is connected through another transformer 20 to a source of low frequency impulses, which in this case comprises a telephone transmitter 21 and a battery 22. By this arrangement the telephonic electromotive forces, generated by transmitter 21 in the winding 7, serve to vary the amplitude of the high frequency oscillations produced by the amplifier 3, and cause to be impressed on the transformer 12 a modulated high frequency wave whose envelop will have the form of the telephonic wave impressed.

The secondary 23 of transformer 12 combines with condenser 24 to form a resonant circuit which is tuned to the frequency of the high frequency carrier waves generated by amplifier 3. Bridged across the terminals of condenser 24 is a resistance 25 of several thousand ohms. This resistance serves as a load of constant impedance on the transformer 12 and has the effect of steadying the action of the system. The resistance 25, in parallel with the condenser 24 and the winding 23, is included in the input circuit of an amplifier 26, also of the thermionic type.

Amplifier 26 serves in the well known manner to amplify the power value of the modulated high frequency oscillations produced by the amplifier 3. In this case, this power amplification is directed mainly to increasing the voltage of the modulated high frequency to the degree necessary for controlling the input circuits of the high current amplifiers 27, 28 and 29.

The features of design, whereby a thermionic amplifier of the type in question may be made to produce either a voltage amplification or a current amplification, are discussed in the Arnold Patent No. 1,129,942 of March 2, 1915, and the Arnold Patent 1,329,558 of January 27, 1920.

The output circuit of amplifier 26 includes the inductance 30 for providing a direct current path for the space current delivered to the amplifier 26 by battery 31. In multiple with the inductance 30 is a condenser 32 which forms with it an anti-resonant circuit tuned to the frequency of the high frequency oscillations, and consequently of high impedance thereto.

The input circuits of the current amplifiers 27, 28 and 29 are bridged in multiple across the terminals of condenser 32. This and also other arrangements for producing the same result are disclosed in the Arnold Patents, 1,129,942 and 1,129,943 of March 2, 1915. In the present case, the cathodes 33, 34 and 35 are connected in series with a battery 36 and an adjustable resistance 37, and are heated to the required degree of incandescence by current supplied from this battery.

The common output circuit of the amplifiers 27, 28 and 29 includes winding 38 of the output transformer 39 and a source of direct current, which, in this case, is shown as a direct current generator 40, though it is obvious that any other source of direct current may be employed. A condenser 41 is preferably shunted about the terminals of the generator 40 in order to furnish a low impedance path for the high-frequency currents.

The secondary winding 42 of the transformer 39 is connected in series with the antenna 43, and serves to impress thereon high-frequency currents of large power value modulated in accordance with the telephonic wave generated by transmitter 21.

The amplifiers 27, 28 and 29 are preferably of the high current type described in the Arnold Patent No. 1,129,948 and in Arnold's application, Serial No. 277,578, filed February 17, 1919, and while, for the sake of illustration, only three of these amplifiers are herein shown, it has been found in practice that any number of such amplifiers may be connected in multiple, depending upon the amount of power required, and that two or three hundred of such amplifiers connected in multiple produce a power amplification sufficient for effective long range communication.

In the development of the system of Fig. 1, which is illustrated in Fig. 2, a slightly different method for modulating the high frequency oscillations is employed. In this case, the high frequency oscillations are generated in a separate thermionic amplifier 50, whose operation will be found described in patent to Hartley 1,356,763, patented October 26, 1920, and which is designed to generate sustained oscillations of a frequency sufficiently high for radiation from an antenna but of a power value comparable with that developed by the transmitter 21. These high frequency oscillations, together with the oscillations of telephonic frequency, are impressed upon the input circuit of an amplifier 51 and serve to produce in the output circuit of this amplifier a modulated high frequency wave similar to that developed by the amplifier 3, as described and claimed in the patent to Van der Bijl 1,350,752, patented August 24, 1920. These modulated high frequency oscillations are subjected to a voltage amplification by means of a plurality of amplifiers of the type of 26, whose filaments 52 are heated in multiple from a common direct current source 53.

The space current for both the amplifier 51 and the amplifiers 26 is supplied from a direct current generator 54, preferably shunted in each case by condensers 55 and 56 of about 1 microfarad capacity each. In this case the output circuit of the voltage amplifiers 26 is coupled by the winding 57 to the resonant circuit made up of the winding 58 and condenser 59. Condenser 59 is shunted by a high resistance 60 and is included in the input circuit of the power amplifiers 27, 28, etc.

It has been found feasible to heat the filaments 33, 34, etc., from an alternating current source, and, as shown in Fig. 2, the filaments 33, 34, etc., are heated from a 60 cycle generator 61. Where an alternating current source is employed for this purpose, the filament circuit should be shunted by an inductance 62, the middle point 63 of which is connected to the output circuit through a

resistance 64. Each half of the inductance 62 is shunted by a condenser 65.

In a practical employment of the system herein described in which effective long range communication has been obtained, six voltage amplifiers of the type of 26 were employed, and were supplied with space current from a generator 54 of 500 volts output. 250 of the amplifers of the type of 27 and 28 were employed, and were supplied with space current from a direct current generator 66 shunted by a condenser 67 of 100 microfarads capacity and delivering space current at a voltage of 600. The filament circuit was supplied by a 60 cycle generator 61 delivering current at a voltage of 10 volts. The inductance 62 was given a value of .4 milli-henry and the condensers 65 each had a capacity of 100 microfarads.

Although this invention has been described in connection with radio signaling, it is also applicable to selective transmission of any kind and to high frequency transmission over conducting circuits as well as to radio transmission.

What is claimed is:

1. The method of signaling which consists in modulating carrier waves of insufficient power for transmission to a distant station and in increasing the power of said modulated waves before they are transmitted.

2. The method which consists in modulating, in accordance with other waves, carrier waves of insufficient power for transmission to a distant station and in increasing the power of said modulated waves before they are transmitted.

3. The method which consists in modulating, in accordance with electric current waves, carrier waves of insufficient power for transmission to a distant station and in increasing the power of said modulated waves before they are transmitted.

4. The method which consists in modulating, in accordance with signal currents, carrier waves of insufficient power for transmission to a distant station and in increasing the power of said modulated waves before they are transmitted.

5. The method of signaling which consists in generating carrier waves, supplying message impulses of a power value comparable to that of said waves, modulating said waves in accordance with said impulses and in amplifying the power value of the modulated waves to a degree sufficient for long distance transmission.

6. In a signaling system, the combination of means for supplying modulated carrier waves, a conductor adapted to transmit said waves, and an amplifier between said means and said conductor whereby said waves are amplified before they are sent to a distance.

7. In a signaling system, the combination of means for supplying modulated carrier waves, a conductor adapted to transmit said waves, and a vacuum tube of the audior type between said means and said conductor whereby said waves are amplified before they are sent to a distance.

8. In a signaling system, the combination of means for supplying modulated carrier waves, a conductor adapted to transmit said waves, and a plurality of vacuum tubes of different types connected in tandem between said means and said conductor.

9. The method of controlling the emission of high power, high frequency waves by means of feeble signal waves which consists in generating feeble high frequency oscillations, modulating said oscillations in their feeble state by means of said feeble signals, and amplifying said feeble modulated oscillations to the high power state in which they are to be transmitted.

10. The method of controlling the emission of high power, high frequency waves by means of feeble signal waves which consists in generating feeble high frequency oscillations, modulating said oscillations in their feeble state by means of said feeble signals, and separately amplifying the voltage and amperage of said feeble modulated oscillations.

11. The method of controlling the emission of high power, high frequency waves by means of feeble signal waves which consists in generating feeble high frequency oscillations, modulating said oscillations in their feeble state by means of said feeble signals, amplifying the voltage, and subsequently amplifying the amperage of the modulated oscillations.

12. The method of controlling the emission of high power, high frequency waves by means of feeble signal waves which consists in generating feeble high frequency oscillations, modulating said oscillations in their feeble state by means of said feeble signals, amplifying said feeble modulated oscillations into modulated oscillations having a relatively high voltage, and in amplifying said high voltage modulated oscillations into modulated oscillations having both a relatively high voltage and a relatively high amperage.

13. The method of controlling the emission of high power, high frequency waves by means of feeble signal waves which consists in generating feeble high-frequency oscillations, modulating said oscillations in their feeble state by means of said feeble signals, and causing said modulated oscillations to vary the potential across the input circuit of a system of thermionic amplifiers having a large power output.

14. The method of radio transmission which comprises modulating a carrier wave

of insufficient power for transmission to a distant station, increasing the power of said modulated wave before transmission, and radiating the energy of said increased power wave.

15. The method of radio telephony which comprises modulating a carrier wave in accordance with speech waves, increasing the power of said modulated carrier wave before transmission, and radiating said wave of increased power.

16. A transmission system comprising means for supplying carrier waves of insufficient power for transmission to a distant station, means for modulating said waves, and means for increasing the power of said modulated waves before transmission.

17. A signal system comprising a source of carrier waves, means for modulating said waves in accordance with signals, a carrier wave transmission conductor, and means connecting said modulating means and said conductor for increasing the power of said modulated waves.

18. The method of transmitting signals through space which consists in generating oscillations of radio frequency having a power value comparable with that of the signal impulses to be transmitted, impressing said oscillations together with said impulses on the input circuit of a thermionic repeater, whereby modulated high frequency oscillations are produced in the output circuit of said repeater, and causing said modulated oscillations to vary the potential across the input circuit of a system of thermionic amplifiers having a large power output.

19. In a signaling system, the combination of means for supplying carrier waves modulated in accordance with signal currents, a conductor adapted to transmit said waves, and an amplifier between said means and said conductor whereby said waves are amplified before they are sent to a distance.

20. In a signaling system, the combination of means for supplying carrier waves modulated by other waves, a conductor adapted to transmit said waves, and an amplifier between said means and said conductor whereby said waves are amplified before they are sent to a distance.

21. The combination with means for generating high frequency oscillations and for modulating said oscillations in accordance with low frequency impulses to be transmitted, of a plurality of current amplifiers arranged in multiple, and a voltage amplifier energized by said means and working into said current amplifiers, whereby the power of said modulated oscillations is increased.

22. The combination with means for generating high frequency oscillations and for modulating said oscillations in accordance with low frequency impulses to be transmitted, of a plurality of thermionic amplifiers arranged in multiple having a common input circuit, and a thermionic amplifier adapted to be energized by said means and working into said input circuit, whereby the power of said modulated oscillations is increased.

23. The combination with means for generating high frequency oscillations and for modulating said oscillations in accordance with low frequency impulses to be transmitted, of a plurality of thermionic current-amplifiers arranged in multiple having a common input circuit and a common output circuit, a thermionic voltage-amplifier associated with said means and working into said input circuit, whereby the power of said modulated oscillations is increased and an antenna circuit coupled with said output circuit.

24. The combination with a thermionic amplifier having an input circuit and an output circuit, of means for impressing a high frequency electromotive force on said input circuit, other means for impressing on said input circuit a low frequency electromotive force of an amplitude comparable with that of said high frequency electromotive force, whereby the amplitude of the oscillations produced in said output circuit is relatively small and is made to vary in accordance with the variations in said low frequency electromotive force, and means connected with said output circuit for amplifying said high frequency oscillations to the high power state in which they are to be transmitted.

25. In a system for radio transmission, the combination with a thermionic amplifier having an input circuit and an output circuit, of means for impressing an audio frequency electromotive force and a radio frequency electromotive force of comparable and feeble intensities on said input circuit whereby a low power modulated high frequency current is produced in said output circuit, and means for amplifying said modulated current to a high power state in which it is to be transmitted.

26. In a system for radio transmission, the combination with a thermionic repeater having an input circuit and an output circuit, of means for impressing an audio frequency electromotive force and a radio frequency electromotive force of comparable magnitudes on said input circuit whereby a modulated high frequency current is produced in said output circuit, and a plurality of thermionic repeaters coupled with said output circuit for amplifying said modulated high frequency currents to a high power value.

27. The method of carrier current telephony which includes generating speech waves and carrier current waves of comparable magnitude, impressing all of said waves upon a modulator, amplifying the modulated carrier waves and transmitting them to a distant station, said carrier waves before amplification being too feeble for transmission and reception at said station.

28. The method of high frequency transmission which includes generating low frequency modulating waves and carrier current waves of comparable magnitude, impressing all of said waves upon a modulator, amplifying the modulated carrier waves and transmitting them to a distant station, said carrier waves before amplification being too feeble for transmission and reception at said station.

In witness whereof, we hereunto subscribe our names this 31st day of August, A. D. 1915.

EDWIN H. COLPITTS.
HAROLD DE FOREST ARNOLD.

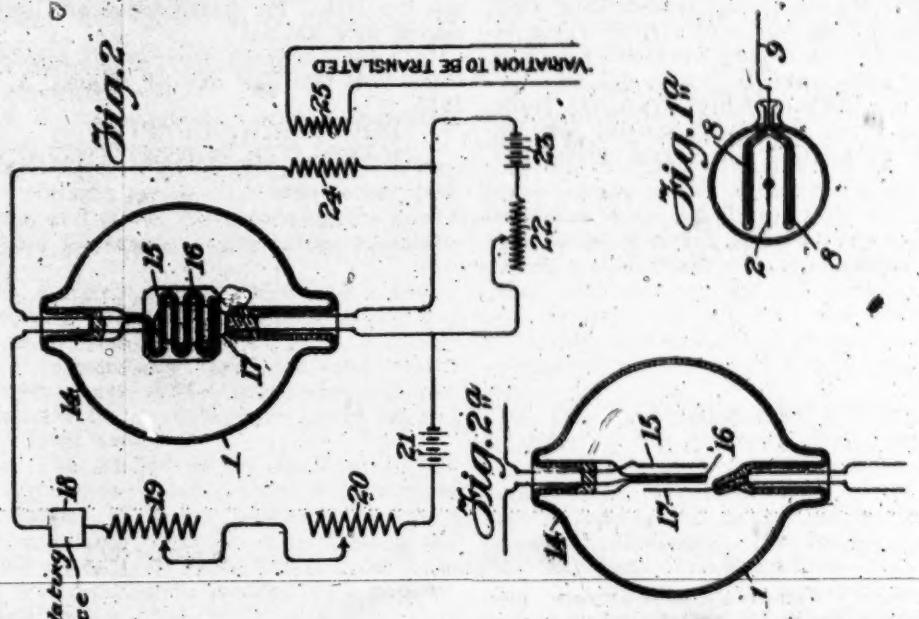
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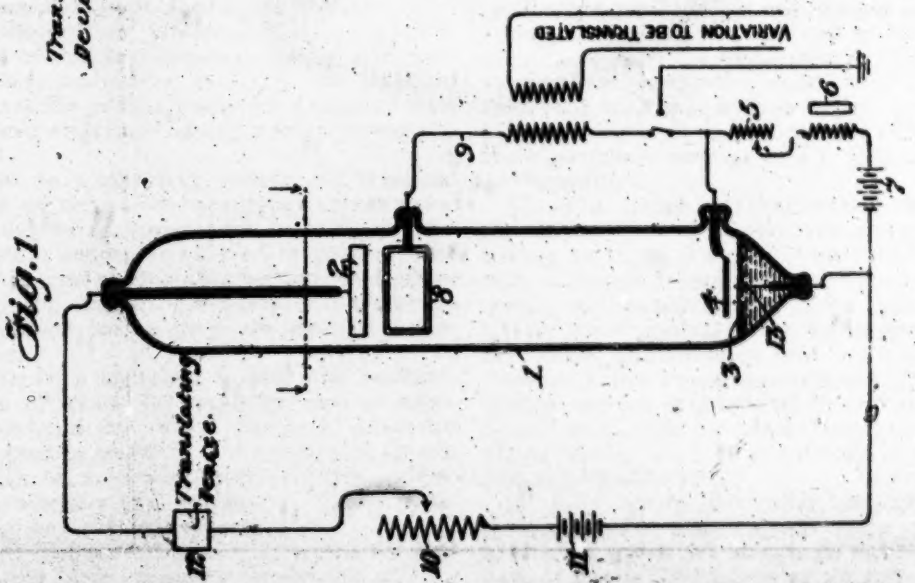
P. C. HEWITT.

APPARATUS FOR TRANSLATING ELECTRICAL VARIATIONS.

APPLICATION FILED MAR. 12, 1915.

1,393,369. Patented Oct. 11, 1921.





WITNESSES

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INVENTOR

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ATTORNEYS

UNITED STATES PATENT OFFICE.

PETER COOPER HEWITT, OF RINGWOOD MANOR, NEW JERSEY.

APPARATUS FOR TRANSLATING ELECTRICAL VARIATIONS.

1,393,869. Specification of Letters Patent. Patented Oct. 11, 1921.

Application filed March 12, 1915. Serial No. 13,873.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and resident of Ringwood Manor, county of Passaic, State of New Jersey, have invented certain new and useful Improvements in Apparatus for Translating Electrical Variations, of which the following is a specification.

My invention relates to means for controlling one circuit by another and is serviceable for affecting a circuit by potential variations in another circuit, insulated from it, even though the currents are alternating currents of very high frequency.

The invention consists of a vacuum, gas or vapor tube consisting of a positive electrode, a negative electrode capable of receiving positive current and of a conductor inside the tube, hereafter called the potential terminal, insulated from the gas or vapor path in the same manner as if it were entirely covered by a coating of insulating material whereby it affects the path between the main electrodes by its potential charge and not by current passing from it to the path by conduction.

It is useful as a receiver for wireless telegraphy and telephony and for transferring telephone currents from one circuit to another and for amplifying and relaying such currents and will serve to translate rapidly varying currents of high frequency, and translate variations of energy.

My invention is best explained by a concrete device, as shown in the drawing, and by a setting forth of the action of said device.

In the drawings, Figure 1 represents a device embodying my invention as connected in circuit. Fig. 1ª is a detail. Figs. 2 and 2ª illustrate a modified form.

In Fig. 1, is shown a vacuum tube, 1, having a positive electrode, 2, a negative electrode, 3, and a keep alive, 4, and a circuit connecting 3 and 4 consisting of resistance, 5, inductance, 6, and a storage battery, 7, for maintaining the electrode 3 in active condition.

A conductor, 8, here called potential terminal, is shown insulated from the vacuum, gas or vapor, and consisting of a material like platinum, for instance, covered by insulating material like glass, for instance, so that the conductor is prevented from carrying current to the interior of the device by true conduction, but is only capable of affecting the interior by reason of the electric charge impressed on the conductor conveyed by means of the conductor, 9, connected to it and passing through the wall of the vessel.

A circuit is connected to the positive electrode 2 consisting of resistance, 10, a battery, 11, and a translating device or indicating instrument, 12, with leads connecting the same to negative electrode 3 or, if preferred, to electrode 4. Current is first caused to pass between auxiliary positive electrode 4 and negative electrode 3 in a desired quantity, say, from ½ to three and one-half amperes, by suitably adjusting the various parts of the circuit 5, 6, 7; it being of advantage that the inductance 6 be large. The negative electrode 3 is stabilized, in case a liquid electrode is used, such as mercury, by a projection, 13, such as platinum or tungsten.

The circuit to the positive electrode 2 is adjusted to pass the desired current by means of the resistance 10, battery 11, and the translating device 12. The current in this circuit is selected according to requirements and may be very small if the device is required to translate very minute variations of energy, as very small potential variations impressed on the potential terminal or conductor 8 will not affect currents of over a certain magnitude, with sufficient force to yield practical results.

The potential variations or energy variations to be translated are applied by means of conductor 9 to the potential terminal, and these variations affect the current flow in the tube circuit, including the indicator, from the positive electrode 2.

The device is sensitive to potential variations applied to potential terminal 8. If the device is used for energy variations of low potential, in order that it may be most sensitive to such variations, the potential of the energy variations should be raised to the highest possible potential at the potential terminal by any of the well known expedients to raise the potential of variations. As there is no current flow from potential terminal, 8, the necessary raising of potential may be brought about with an exceedingly small amount of energy to be translated. One terminal of such a device should be connected at 9, and the other side of the circuit to any of the other leads entering the device, or may be connected to ground or the capacity of the circuit may be sufficient.

Instead of a plate as shown as the potential terminal at 8, Fig. 1, a perforate terminal such as a grid of insulated wire may be used and may be turned in a horizontal position instead of vertical as shown at 8, in Fig. 1. One form of such grid is shown at 16, in Fig. 2. The perforate terminal or the wire forming the grid may be covered with a coating of glass, preferably thin, or other suitable insulating material.

In place of a mercury electrode maintained in a broken down state by current flow from an auxiliary positive electrode and independent source of current, an incandescent body may be used as the electrode, such as the filament of an incandescent lamp, which may be maintained hot by an independent circuit.

Fig. 2 comprises a device wherein a filament, 17, serves as a negative. The filament 17 is included in a separate circuit consisting of a battery, 23, and a variable resistance 22 for maintaining it incandescent so that it may act as a negative to receive positive current.

Variations are applied by means of primary coil, 25, acting on secondary coil, 24, which serves as a potential raising device; one terminal of 24 is connected to the potential grid 16; the other terminal is connected to the filament circuit. The positive electrode, 15, is connected to the indicating instrument, 18, included in a circuit having inductance, 19, resistance, 20, battery, 21, and connected to the negative electrode terminal, the circuit being completed by means of the path between the electrodes 15 and 17, inside the device. The potential impressed on the potential electrode 16 varies the current flow in the circuit 15, 18, 19, 20, 21, and 17.

Any suitable translating device or indicating instrument, such as the primary of a transformer, the secondary of which may be utilized for any desired purpose, or a telephone receiver, or a relaying apparatus, may be used at 12 or 18 in Figs. 1 and 2.

The device is also useful when alternating currents are applied to the main electrodes instead of direct current here illustrated, in which case the device will rectify the current and pass direct current impulses.

With very high frequency currents the device is very useful.

I claim as my invention:

1. In an apparatus for translating electrical variations, an electric device having a potential terminal located therein and completely covered with insulating material, said insulated potential terminal being separately mounted in said device.

2. In an apparatus for translating electrical variations, a container, electrodes therein separated by a vacuum, gas or vapor space, and a conductor within the container covered throughout with insulating material.

3. In a vacuum, gas or vapor apparatus, a container having electrodes and a potential terminal within the container covered throughout with insulating material, said internal potential terminal being in operative relation to the electrodes and spaced apart therefrom, and means for impressing electrical variations upon said internal potential terminal.

4. In an electric apparatus, a container having electrodes therein separated by a vacuum, gas or vapor space, and a conductor within the container covered throughout with insulating material, and means for impressing electrical variations upon said internal conductor.

5. In an electric apparatus, a container having positive and negative electrodes therein separated by a vacuum, gas or vapor space, means for passing current between said electrodes, and a conductor within the container covered throughout with insulating material in operative relation to the current path between the electrodes, and means for impressing electrical variations on said internal conductor.

6. The combination in a vacuum, gas or vapor device, of two electrodes having a current path between them and a conductor within the device interposed between the two electrodes and insulated from the current path.

7. A vacuum, gas or vapor device, having two electrodes and a current path between them and a conductor within the device interposed between the two electrodes and insulated from the current path, in combination with a source of electrical variations connected with the insulated conductor, a receiving circuit, and a translating device therein.

8. In a vacuum, gas or vapor device, two electrodes having a current path between them, a conductor within the device interposed between them and insulated from the current path, in combination with means for raising the electrical energy applied to the insulated conductor to the highest practical potential.

9. A vacuum, gas or vapor device having positive and negative electrodes, a conductor within the device spaced apart from said electrodes and insulated from the vacuum, gas or vapor path between the positive and negative electrodes in combination with means for impressing potential variations on the insulated conductor, a circuit including one of the main electrodes of the device, and a translating device responsive to currents therein.

10. In a vacuum, gas or vapor device, two electrodes having a current path between them, a conductor within the device inter-

posed between the two electrodes and insulated from the current path, in combination with an source of electrical variation acting on the insulated conductor, and means for raising the potential of the said variations.

11. The combination with an exhausted container, electrodes therein having a vacuum, gas or vapor current path between them, of a body of conducting material within the container spaced apart from said electrodes and insulated from the current path, and means for making electrical connection with the insulated conductor through the walls of the container.

12. The combination with an inclosing chamber, 1, a positive electrode, 2, a negative electrode, 3, and a potential terminal within the chamber spaced apart from said electrodes and insulated from discharges passing between the said electrodes.

13. In an apparatus for amplifying electrical variations, an electric device having electrodes, means for passing electric current between said electrodes, a body of conducting material within said device interposed in the path between the electrodes and insulated from said path.

14. An amplifier for electrical variations, comprising an evacuated container, a positive and a negative electrode, means for passing electric currents between the same, an insulated potential terminal within said container and spaced apart from said electrodes and receiving electrical charges corresponding to the variations to be amplified and affecting the current path but insulated therefrom.

Signed at New York, in the county of New York and State of New York, this 11th day of March, A. D. 1915.

PETER COOPER HEWITT.

Witnesses:

WALTER E. F. BRADLEY,
HAROLD B. WOODWARD.

1541

H. DE F. ARNOLD.
THERMIONIC AMPLIFIER.
APPLICATION FILED JAN. 8, 1920.

1,398,665. Patented Nov. 29, 1921.

Fig. 1

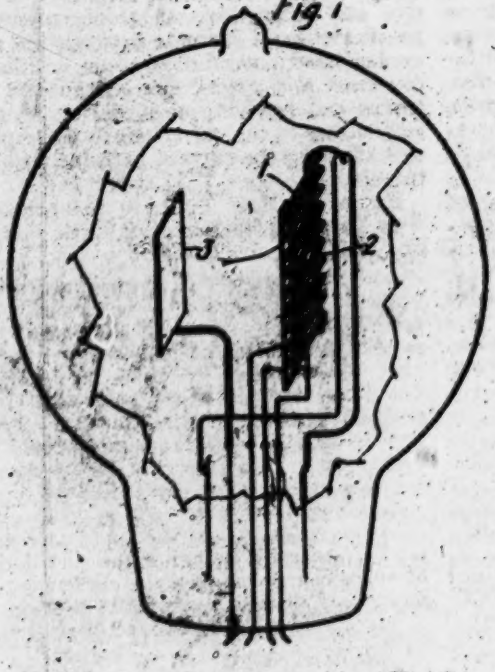


Fig. 2

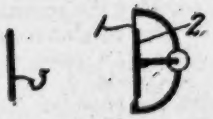
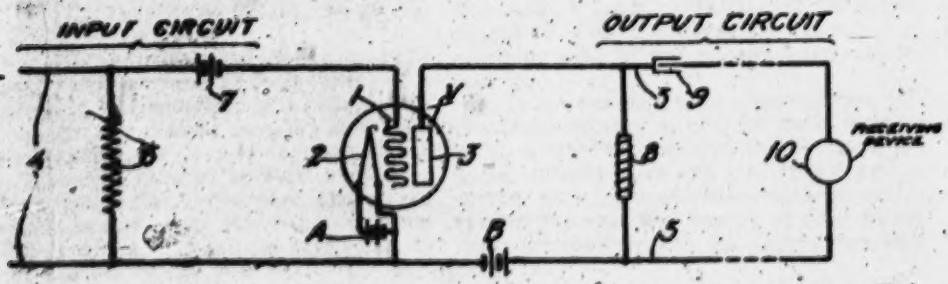


Fig. 3



Inventor
Harold D. Arnold
by C. L. Sprague Atty.

UNITED STATES PATENT OFFICE.

HAROLD D. ARNOLD, OF MAPLEWOOD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

THERMIONIC AMPLIFIER.

1,398,665. Specification of Letters Patent. Patented Nov. 29, 1921.

Original application filed July 30, 1913, Serial No. 847,622. Patent No. 1,229,283, dated January 27, 1920. Divided and this application filed January 8, 1920. Serial No. 350,197.

To all whom it may concern:

Be it known that I, HAROLD DE FOREST ARNOLD, a citizen of the United States, residing at Maplewood, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Thermionic Amplifiers, of which the following is a full, clear, concise, and exact description.

This invention relates to thermionic amplifiers of the electric discharge type and more particularly to those of the three element type, preferably highly evacuated, and its object is to provide a structure by which certain desired characteristics of the amplifier may be secured at will and in an efficient manner. This object is accomplished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in this specification.

In order that the novelty of this invention may be appreciated, and that those skilled in the art may be enabled to use this invention to best advantage, it is necessary that certain terms hereinafter used shall be defined. The following brief discussion is intended to explain the operation of the device and to define the terms to be employed.

The thermionic amplifier consists of a container preferably although not necessarily highly evacuated and including a hot electron-emitting cathode, such as the so-called "Wehnelt" cathode, an anode and an auxiliary electrode called the grid, which is usually, though not always located between the anode and the cathode. A battery is connected so as to force the electrons liberated at the cathode toward the anode, thus setting up a convection current carried by electrons in the evacuated space. In this specification since only the structure of the device itself is under discussion, only the effects of changes in that structure are considered. Obviously a change in the battery will also change the characteristics of the circuit, but in a way which is already known in the art. Due to the presence of these electrons, a negative space charge is established between the anode and the cathode, whose effect is to limit the number of electrons which can leave the cathode, and consequently to limit also the current which can flow in the output circuit, by which is meant the circuit including the battery and the path of the space current. The object of the grid is to furnish a means for introducing a further negative charge into the space between the anode and the cathode, or for introducing into it a positive charge which shall neutralize the effect of part of the space charge due to the electrons. In the first case, the convection current is decreased; in the second it is increased. In order to force this charge to the grid, a source of electromotive force is connected between grid and cathode, that is, between the input terminals of the device. The effect of such an impressed electromotive force is therefore to alter the magnitude of the space current in the amplifier by changing the distribution of space charge between the electrodes, and moreover this is accomplished without requiring that the impressed electromotive force shall do more work than that involved in forcing the charge to the grid against the counter voltage of the condenser formed by grid and filament. Since in this operation the change in power consumed in the output circuit may be much greater than that required in charging the condenser, the device acts as an amplifier. This variation in space current, due to an impressed electromotive force, will hereafter be called the output current of the amplifier and the variation in voltage, which appears in the output circuit due to the impressed electromotive force, will be called the output voltage. The reason for adopting these definitions is that in the practical applications of the amplifier it is only these variations in current or voltage which are utilized; in fact, a transformer is ordinarily used to derive power from the output circuit, and obviously the steady space current or the steady output voltage have no effect in the secondary of that transformer and may be ignored for practical purposes. Thus, the term voltage amplification means here the ratio of the alternating voltage appearing in the secondary of such a unity ratio transformer to the alternating voltage impressed across the filament and grid, when the transformer primary is made to include the whole of the output circuit external to the am-

plifier. In simpler terms, it is the ratio of the above defined output voltage to the impressed input voltage.

There will also be occasion to consider the ratio of output current to input voltage, the latter being taken as standard throughout. When this ratio is high, other things being the same, the amplifier will be said to be of the high current type, and vice versa. This latter ratio is, of course, not a pure number, but is of the nature of an admittance.

It has been found that amplifiers may be designed for given circuit conditions so that they will have whichever of the above mentioned characteristics is desired. That is, one may be designed to deliver to a receiving device a comparatively high voltage with a low current, or vice versa. The principles of operation which have been discovered which enable this result to be accomplished may be stated as follows.

In the first place it has been found that it is of advantage to locate the grid as near the cathode as possible whatever the desired voltage amplification or output current. In practice it has been found that when the two elements are separated only by a mere oxidising coating the most efficient action is obtained. Unless there is a solid and continuous spacing element between the two it may be necessary of course to separate them a small distance to prevent actual contact between them due to forces set up during operation. By saying that the elements are placed as close together as possible it is meant that the distance between them is made as small as possible without introducing appreciable electrical or mechanical disturbances during operation.

Again, it has been found that, when the cathode and grid are placed as near to each other as possible, decreasing the distance from the anode to the cathode decreases the voltage amplifying power of the tube without at the same time reducing the variable current set up in the output circuit. That is, if we consider two tubes, one of which has the anode and cathode widely spaced while the other has them near together, the grid being very close to the cathode in each case, the first tube when installed in a system of the usual kind, tends to cause marked voltage amplification, while the latter, if substituted for the former, increases the variable current output, and at the same time lowers the voltage amplification.

A third principle of operation of the thermionic repeater which has been discovered may be stated as follows. To increase voltage amplification decrease the ratio of open space in the grid to conducting surface, and to decrease voltage amplification or to increase the variable output current increase this ratio.

The behavior of thermionic repeaters in another very important respect has been discovered. This may be stated as a fourth principle of operation as follows: Maximum efficiency is obtained when the impedance between the anode and cathode is equal to the total impedance of the variable current consumption circuit. This total impedance includes the total line impedance and that of the receiving or translating device or devices to which power is being supplied.

It has been found that tubes may be constructed in such manner as to take advantage of any number or of all of the above mentioned principles with, of course, correspondingly increased efficiency and adaptability.

An object of the invention is to provide an audion, or equivalent system, by which a proper impedance ratio is obtained between the impedance of that portion of the output circuit which is without the audion and that of the remaining portion of the external circuit, whereby a greatly increased efficiency is obtained.

Another object of the invention is to provide an audion, or equivalent device, which will operate efficiently with a current operated translating device without the use of a voltage transformer between the audion and the translating device.

Viewed broadly, the invention provides for an increase of the efficiency of an audion, or equivalent device, by novel spacing of the electrodes and the current control element, and also an increase of efficiency, when used with a current operated translating device, by obtaining the proper ratio of the conductive surface to open space in the grid or current control element.

Other and more specific objects of the invention will be apparent from the appended claims.

The invention will be better understood by reference to the following specification taken in connection with the accompanying drawing in which—

Figure 1 represents the structure of an amplifying tube which is designed to give greater voltage amplification than those of the prior art; Fig. 2 is a plan view of the amplifier of Fig. 1 arranged to exhibit the geometrical configuration; Fig. 3 is a circuit diagram showing an amplifying system making use of an amplifier of the type shown in Fig. 1. In these figures, like numerals represent corresponding parts.

Referring to Figs. 1 and 2, 1 represents the grid element, 2 the cathode or filament and 3 the anode or plate. The plate is placed a considerable distance from the cathode, and the grid is placed very close to the cathode and may be separated therefrom only by a thin insulating film as, for

example, an oxidizing coating on one or the other of these elements. Further, the grid is made to have a fine mesh and thus to obstruct greatly the view of the plate as seen from the cathode.

Fig. 3 is a diagram of an amplifying system in which a tube V of the type shown in Fig. 1 is employed. The tube has the usual input circuit 4, and output circuit 5, 5. The exact arrangement of input and output circuits is that shown in Patent 1,129,942 to this applicant. In this patent there is shown and claimed a combination with another system of a system of the type shown in Fig. 3, such combination having marked advantages for certain purposes specified in said patent. The purpose of the present application is to specifically describe and claim a system employing novel thermionic amplifiers, these being capable of more general use than that disclosed and claimed in the above mentioned patent.

A source of potential 7 may be inserted in the input circuit to bring the grid to a desired initial or working potential. No transformer need be used, the incoming line being directly connected to the input electrodes, and the outgoing line, to the output electrodes. A high resistance element 6 may be connected across the input circuit as shown. A coil 8 of large inductance provides a path for direct current for the tube V, such current being supplied by a source B. The coil 8 will not conduct an appreciable amount of the variable current in the output circuit owing to its high impedance to such current. The condenser 9 is inserted in the line to prevent flow of direct current from the source B through the receiving device 10 if the latter does not itself prevent such flow.

The receiving device 10 may be one which operates most efficiently upon high variable voltage and low current. In accordance with the principles discussed above, the grid 1 and cathode 2 are placed very close together while the plate 3 is widely separated from the cathode, the distance between the two being that necessary to give the desired current and voltage output characteristics. It is usually necessary however for efficient operation to consider first the impedance characteristics of the tube between filament and plate and the impedance of the receiving device and line, in accordance with the fourth principle of operation stated above. The receiving device 10 is one of high impedance and accordingly the impedance of the tube between filament and plate is made high, the two impedances being made as nearly the same as possible consistent with other possible conflicting requirements. They should at least be of the same order of magnitude, for example one being 100,000 ohms and the other 25,000 ohms. The receiving device 10 may be a second amplifying tube or similar device.

By thermionic repeater is meant a repeater depending for its operation upon current discharge from a heated cathode. It is obvious, however, that the invention might be applied to a discharge device in which other means is employed for liberating electrons from the cathode. In its broadest aspect the invention is not limited to the particular structure herein illustrated, but may be found useful in modified forms or types of discharge tubes and in connection with a variety of circuit arrangements—as for example, those illustrated in Figs. 9 and 10 of the copending application of H. D. Arnold, which matured into Patent No. 1,329,283, dated Jan. 27, 1920, of which the present application is a division.

What is claimed is:

1. A thermionic discharge device having a cathode, an anode and a controlling element, said controlling element being located in close proximity to the cathode, and said anode being relatively widely spaced from said cathode whereby the device operates to repeat electrical waves and impulses with amplified voltage.

2. A thermionic discharge device having a cathode, an anode and a controlling element, said controlling element being located in close proximity to the cathode, and said anode being relatively widely spaced from said controlling element whereby the device operates to repeat electrical waves and impulses with amplified voltage.

3. The combination with a thermionic discharge device having a cathode, an anode, and an impedance varying element of an input circuit and an output circuit therefor, means for producing a variable electromotive force in said input circuit, a source of electromotive force in said output circuit, and translating means for utilizing the variable current of said output circuit, said impedance varying element being in immediate proximity to the cathode, but out of electrical contact therewith, and said cathode being widely spaced from said anode so that for the impedances and voltages employed outside the device, the device operates to amplify the voltage of energy impressed upon said input circuit.

4. The combination with a thermionic discharge device having a cathode, an anode, and a controlling element of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and controlling element being so spaced that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit and that said device operates as a voltage amplifier.

5. The combination with a thermionic dis-

charge device having a cathode, an anode, and an impedance varying element, of an input circuit and an output circuit therefor, an impedance element in said output circuit, means for producing a variable electromotive force in said input circuit, and a source of electromotive force in said output circuit, said cathode being as near as possible to said impedance varying element and said anode being relatively widely spaced from said cathode whereby the variable voltage across said anode and cathode in said output circuit is much greater than that in said input circuit.

6. The combination with a thermionic discharge device having a cathode, an anode, and an impedance varying element, of an input circuit and an output circuit therefor, an impedance element in said output circuit, means for producing a variable electromotive force in said input circuit, and a source of electromotive force in said output circuit, said cathode being in immediate proximity to said impedance varying element, said anode being relatively widely spaced from said cathode, and said impedance varying element being in the form of a discontinuous conductive surface, the ratio of conductive surface to open space in said impedance varying element being high, whereby the variable voltage across said anode and cathode in said output circuit is much greater than that in said input circuit.

7. A thermionic discharge device having a cathode, an anode and a controlling element, said controlling element being located in close proximity to the cathode, said anode being relatively widely spaced from said cathode, said controlling element being in the form of a discontinuous conductive surface having a high ratio of conductive surface to open space whereby the device operates to repeat electrical waves and impulses with voltage amplification.

8. Means for amplifying the voltage of electrical waves and impulses comprising an electric discharge device having a cathode, an anode, and a controlling element, said controlling element being located in close proximity to the cathode, said anode being relatively widely spaced from said cathode, an output circuit connected to said cathode and anode, a translating device to which waves of amplified voltage are delivered connected in said output circuit, the impedance of that portion of said output circuit which is within said discharge device being of the same order of magnitude as the impedance of said translating device.

9. Means for amplifying the voltage of electrical waves and impulses comprising a thermionic discharge device having an anode, a cathode, and an impedance varying element, said impedance varying element being located in close proximity to the cathode, and said anode being relatively widely spaced from said cathode of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit non-magnetically connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit.

10. Means for amplifying the voltage of electrical waves and impulses comprising an electric discharge device having an anode, a cathode, and a current control element, said current control element being located in close proximity to the cathode, and said anode being relatively widely spaced from said cathode, an input circuit for said device, a source of variable energy to be amplified connected in said input circuit, and a work circuit to which the amplified energy is delivered non-magnetically connected to said output circuit.

In witness whereof, I hereunto subscribe my name this 7th day of January, A. D. 1920.

HAROLD D. ARNOLD.

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1546

K. S. JOHNSON.
TRANSMISSION SYSTEM.
APPLICATION FILED JULY 1, 1918.

1,432,863. Patented Oct. 24, 1922.

Fig. 1.

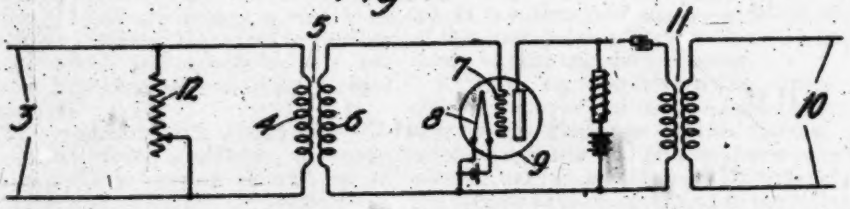
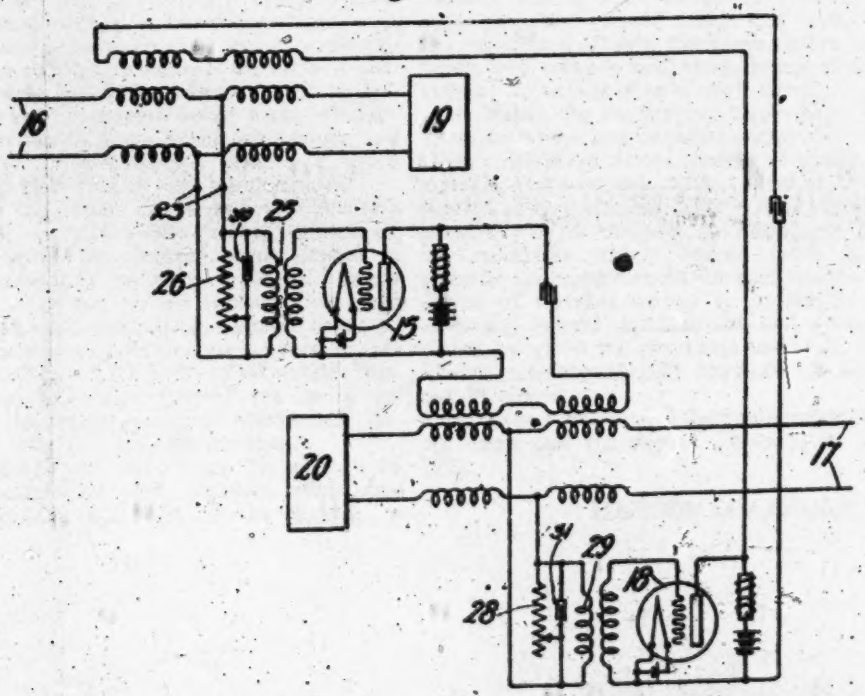


Fig. 2.



Inventor:
Kenneth S. Johnson.
by J. R. Roberts Atty.

Patented Oct. 24, 1922. 1,432,863

UNITED STATES PATENT OFFICE.

KENNETH S. JOHNSON, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TRANSMISSION SYSTEM.

Application filed July 1, 1918. Serial No. 243,797.

To all whom it may concern:

Be it known that I, KENNETH S. JOHNSON, a citizen of the United States, residing at Jersey City, in the county of Hudson, State of New Jersey, have invented certain new and useful Improvements in Transmission Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to transmission systems, more particularly it relates to means for improving the quality of transmission from an incoming line to a vacuum tube repeater.

It is well known in the art of telephony, that the proper functioning of a transmission system depends, to a great extent, on the relative proportioning of the electrical impedances of the component elements of the system. Thus it has been found that the voltage impressed by a transformer from an incoming line on a repeater varies considerably with the frequency, thereby impairing the quality. In accordance with this invention, it has been found that the quality of transmission in such a circuit may be considerably improved by shunting an impedance across the input side of the transformer. On a one-way repeater circuit the value of the impedance may be varied between considerable limits, although in general, a resistance of the order of the effective resistance of the line has been found quite satisfactory. In two-way repeater circuits where accurate balancing between the lines and the artificial networks is required, the value of the impedance across the input side of the transformers should be equal to one-half the impedance of the incoming line. That this value should hold for two way repeater circuits will be apparent from the detailed description of this invention.

Previous to this invention it has been known that the quality of transmission could be improved by connecting across the terminals of the secondary winding of the input transformer a resistance equal to the value of the effective resistance of the line multiplied by the square of the ratio of turns of the transformer, but such an arrangement necessitates the use of a very high and more costly resistance compared with that employed in this invention. For good repeater operation, it is also preferable to have as little apparatus as possible associated with the input circuit of a repeater, because of capacity effects that might result therefrom, which would cause a substantial short circuit between the input electrodes of the repeater and a lowering of its efficiency.

It has been found that there is also less energy lost in the input transformer when the resistance is on the input side and also less liability for cross-talk between neighboring repeater circuits. Experiment has furthermore shown that a greater amplification may be obtained from a repeater having the resistance across the input side rather than the output side of the transformer.

This invention will be better understood by reference to the detailed description of the drawings, in which Figure 1 shows this invention in connection with an incoming line inductively associated with a vacuum tube repeater for one-way operation, while Figure 2 shows this invention in connection with a two-way repeater circuit.

Referring to the drawing, 3 is an incoming line which terminates in the primary winding 4 of a transformer 5, the secondary 6 of which is connected between the grid 7 and cathode 8 of a vacuum tube repeater 9. Signals impressed upon the input circuit of the tube 9 by the line 3 are therefore reproduced in amplified form in the output circuit of the tube and the amplified signals may be impressed upon an outgoing line 10 by a transformer 11.

In order to prevent the voltage impressed by the transformer 5 on the amplifier 9 from varying with the frequency, it is desirable to insert a resistance 12 in shunt to the primary winding. From a quality standpoint the smaller the value of this resistance the better the quality, but it is apparent that making the resistance very small would improve the quality only at considerable expense to the transmission efficiency of the system.

In general it will be found that for transmission lines a value of the resistance 12 of the order of the effective resistance of the incoming line will be quite satisfactory.

In Figure 2, 15 is a vacuum tube for repeating signals from the line 16 to the line 17, while 18 is a vacuum tube for repeating signals in the opposite direction. 19 is an artificial network for simulating the impedance of the line 16 and should have an impedance equal to the impedance of the line.

Similarly the network 20 should simulate the impedance of the line 17. In accordance with this invention the impedance of the circuit at the point 23 should be the same looking in either direction, and since the incoming circuit for the transformer comprises in parallel the line 16 and the artificial line 19, the effective resistance at the terminals 23 looking in the direction of the incoming circuit is one-half the effective resistance of the line 16. The value of the resistance 26 should then be equal to one-half the resistance of the line 16. Similarly, resistance 28 across the primary winding 29 should equal one-half the effective resistance of line 17. With such values for resistances 26 and 28, the balance conditions necessary for no local circulation of power in the repeater station are obtained.

The resistances 26 and 28 will in some cases provide a sufficiently accurate simulation of the impedance of lines 16 and 17. In case that these lines have an appreciable amount of reactance as well as resistance, the reactance component of the impedance may be simulated by reactances such as condensers 30 and 31 in shunt to the resistances 26 and 28 respectively. The circuit or mesh provided by resistance 26 and condenser 30, and by resistance 28 and condenser 31 is commonly called a network or artificial line.

Although this invention has been described above in connection with circuits employing vacuum tube repeaters, it is evident that it is also applicable to circuits in which other types of repeaters such as mechanical repeaters are employed.

It is obvious that the principles above set forth may be embodied in systems widely different from that described herein without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In combination, an incoming line, a translating device, a transformer having a primary winding connected with said line and a secondary winding connected with said device, and an impedance connected to the primary side of said transformer and having an impedance closely approximating the effective impedance of said line.

2. In combination, an incoming line, a transformer having its primary winding connected with said line, a repeater for said line connected with the secondary winding of said transformer, and a resistance element connected in shunt to the terminals of said primary winding for improving the quality of transmission from said line to said repeater, said element having a resistance closely approximating the resistance of said incoming line.

3. The combination with an incoming circuit, of a transformer having its primary connected to said line, a vacuum tube associated with the secondary winding of said transformer, and a resistance connected across the terminals of said primary, said resistance having a value closely approximating the resistance of said circuit.

4. A two-way repeater circuit comprising an actual line, an artificial line and a circuit connected between said lines comprising a transformer, an artificial line connected at the primary of said transformer and a repeater connected to the secondary of said transformer.

5. A two-way repeating system comprising an incoming line, an outgoing line, a uni-directional path for repeating between said line comprising an amplifying element, a transformer for connecting said element to said incoming line, and an impedance connected in shunt to the primary of said transformer, said impedance having a value closely approximating one-half of the impedance of said incoming line.

6. A two-way repeater circuit comprising two lines, a vacuum tube for repeating signals from one of said lines to the other of said lines, a second vacuum tube for repeating in the opposite direction, a transformer connecting the input of each of said repeaters with one of said lines, and an artificial network in shunt to the primary of each of said transformers.

7. In combination, an incoming line, a translating device, a transformer having a primary winding connected with said line and a secondary winding connected with said device, and an impedance in shunt to said primary winding, said impedance having such a value that the impedance between the points across said line adjacent said impedance, looking in the direction of said impedance and said transformer, closely approximates the impedance looking from said points in the direction of said incoming line.

8. A two-way repeating system comprising two line sections, a balancing network for each of said line sections, a uni-directional path for repeating in one direction between said lines, a second uni-directional path for repeating in the opposite direction between said lines, each of said paths comprising a vacuum tube amplifier, a transformer for coupling said amplifier to one of said lines, and a resistance element in shunt to the primary winding of said transformer for causing the voltage impressed on the amplifier to be substantially constant over a wide range of frequencies, said resistance having a value closely approximating the resistance of one of said lines and its balancing network connected in parallel.

In witness whereof, I hereunto subscribe my name this 24th day of June A. D., 191

KENNETH S. JOHNSON.

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PAGE

1550

Oct. 20, 1925. 1,558,436

I. LANGMUIR

ELECTRICAL DISCHARGE APPARATUS AND PROCESS OF PREPARING AND USING THE SAME

Original Filed Oct. 16, 1915

Fig. 1.

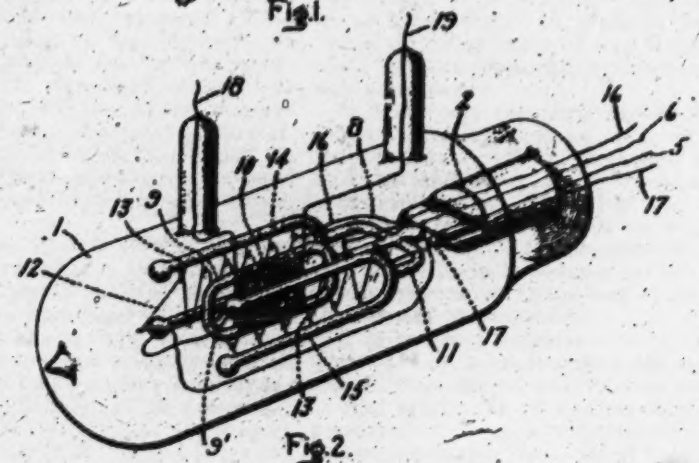


Fig. 2.

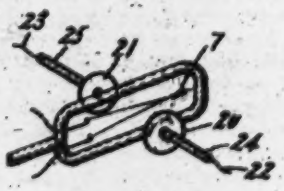


Fig. 3.



Fig. 4.

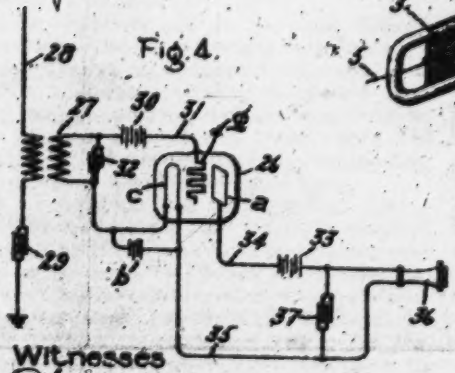
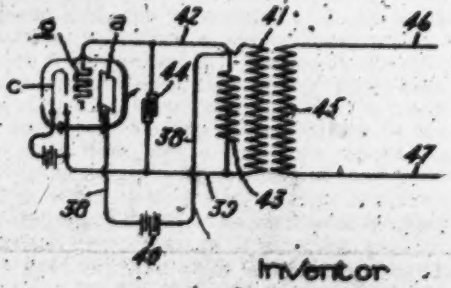


Fig. 5.



Witnesses

J. Ellis Glen

Inventor

Irving Langmuir

by Albert G. Davis

His attorney

Patented Oct. 20, 1925. 1,558,436

UNITED STATES PATENT OFFICE.

IRVING LANGMUIR, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL DISCHARGE APPARATUS AND PROCESS OF PREPARING AND USING THE SAME.

Application filed October 16, 1913, Serial No. 795,610. Renewed March 14, 1918. Serial No. 24,248.

To all whom it may concern:

Be it known that I, IRVING LANGMUIR, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electrical Discharge Apparatus and Processes of Preparing and Using the Same, of which the following is a specification.

The present invention relates to electrical vacuum discharge devices, and it comprises devices in which the electrical current is carried by negative charges called electrons, emanating from the cathode, independently of gaseous ionization such as occurring, for example, in the ordinary Roentgen tube.

My present invention comprises improvements in electron-discharge apparatus which make possible a high load capacity and operation with the highest voltages but the invention is also applicable and useful for moderate loads and moderate voltages. The novel features of my invention will be pointed out with greater particularity in the appended claims.

Figs. 1 and 2 of the accompanying drawings, Fig. 2 being a partial view, illustrate two types of discharge devices embodying my invention; Fig. 3 is a fragmental view showing a cathode construction, and Figs. 4 and 5 are diagrams of electrical systems illustrating certain applications of my electron discharge tubes.

In order to distinguish electron discharge devices made in accordance with my invention from the prior art, I will explain briefly the character of a pure electron discharge as distinguished from a discharge through ionized gas. In a Geissler tube, and in a Roentgen or Crookes tube the conduction of current is accompanied by and depends upon gas ionization. Without a certain minimum amount of gas a Roentgen X-ray tube ceases to operate and as this minimum is approached the resistance of the tube steadily increases.

The passage of an electric current across a tube ordinarily involves the movement of negative charges called electrons which, under the influence of the impressed voltage, pass from the cathode to the anode through the vacuous space. If these electrons when moving above a certain velocity collide with gas molecules they tend to ionize the molecules, splitting them up in electrons and larger and more slowly moving ions. Under these circumstances the phenomena of conduction across the tube are the result of the action and interaction of the electrons and the ions; these phenomena are in general erratic and non-reproducible. The cathode under these conditions is disintegrated, technically it is "sputtered"; which causes its rapid destruction. As gas ionization continues at higher voltages a blue glow may appear. The bombardment of the cathode by positive ions also causes heating of the cathode. The ionization of gases at low pressures by collision with electrons occurs at definitely determinable voltages, these voltages being known as the ionization voltages. These voltages are different for different gases. In the case of gases such as nitrogen, hydrogen, oxygen, argon, helium and neon, they are of the order of magnitude of fifteen to twenty-five volts.

The phenomena above described as being characteristic of devices involving gas ionization are taken advantage of in an incandescent cathode device with three electrodes known as the "Audion." This device has been used as a receiver for radio-telegraphy and depends in its operation upon the rapid change of the discharge current when gas ionization begins. This point depends upon various accidental conditions which cause such irregularities in the operation of various devices apparently identical that sometimes only one of a considerable number can be used. Ordinarily the gas ionization in the audion begins to be important somewhere between 20 and 30 volts. Another discharge device previously used to some extent was the Fleming valve. This was a two-electrode tube which, so far as I am aware, was always used at voltages well below the voltages at which positive ionization by collision occurs. It was not evacuated in such a manner as to permit it to be used at voltages materially above these ionization voltages without manifesting substantial positive ionization effects. No prior hot cathode devices are known to me operating with currents as great as about 5 milliamperes with voltages as high as about 200 volts; indeed no prior discharge devices are known to me operating in a practically usable manner and without substantial positive ionization

effects with currents as great as about one-tenth of a milliampere with voltages as high as about forty volts.

In devices made in accordance with my invention gas ionization is either entirely absent or is negligible and a discharge takes place which is distinct in its characteristics from the described discharge taking place in an ionized gas. The cathode is not heated by the discharge itself. Blue glow, glass fluorescence and in fact all readily visible indications of a discharge are ordinarily absent. In most devices of simple construction which embody my invention, the discharge current passing through a given space with the cathode at a sufficiently high temperature with respect to the voltages employed, varies directly with the 3/2 power of the impressed voltages. This 3/2 power law can be readily derived mathematically for a tube in which there is substantially no positive ionization on the assumption that the whole surface of the cathode is at a uniform potential, that the electrons escape from the cathode with negligible velocities and that the walls of the tube do not carry appreciable electric charges.

In most simple devices embodying my invention, these conditions are so well fulfilled that the current does vary in proportion to the 3/2 power of the voltage over wide ranges of voltage above the ionizing voltages. This means that if the logarithm of the current is plotted against the logarithm of the voltage, the resulting plot is a straight line whose slope is 3/2. Or, in many cases it is more convenient to make use of the equivalent relation, that the 2/3 power of the current plotted as ordinates against the anode voltages as abscissæ gives a straight line.

In devices in which there is substantial positive ionization, on the other hand, even when the pressures of gas are so low that only very small currents could be carried by positive ions, the currents begin to increase with voltage more rapidly than according to the 3/2 power law as soon as the anode voltage materially exceeds the ionizing potential of the gas.

In devices embodying my invention which have more than two electrodes, or with special constructions, as where the cathode is a filament, so long that it cannot be considered an equi-potential surface, the 3/2 power law may be more or less masked. However, the effects thus introduced will be readily understood by those skilled in the art, and appropriate methods of identifying the pure electron discharge can easily be found corresponding to the special construction. For example, when such tubes have more than two electrodes and the temperature of the cathode is sufficiently high with respect to the voltages employed, the discharge will usually be characterized by a linear relation between the 2/3 power of the total electron current from the cathode and the voltage applied to any other electrode, the remaining electrodes being kept at constant potential. Another test that can often be made with a three electrode tube is to connect the grid directly to the anode, or to the negative end of the cathode, and observe whether the current varies as the 3/2 power of the voltage.

If for a given cathode temperature the voltage is sufficiently high to cause all of the electrons emitted or liberated at the cathode to be drawn away, then a further increase in voltage produces substantially no change in the current. The current thus determined is called the saturation current, and the range of operation in which the current is substantially independent of the voltage or approaches this condition may be called the saturation range or more briefly designated merely as saturation. If for a given cathode temperature the voltage is not high enough to cause all of the electrons which are emitted or liberated at the cathode to be drawn away, the operation occurs in a range below the saturation range. Operation in this range may be spoken of as operation below saturation.

A change in the temperature of the cathode in a hot cathode device embodying my invention will produce no change in the discharge when the operation is below saturation, even though the ionization voltage is materially exceeded. That is, the current-voltage curve is not changed by a change in the cathode temperature under such conditions.

The discharge in devices embodying my invention is practically independent of the pressure when the pressure is below a certain value which depends upon the size and shape of the device and upon the current and voltage of the discharge.

As distinguished from discharges in the presence of positive ionization, the pure electron discharge is characterized by regularity and reproducibility with given conditions. In a device in which the conduction of current is purely electronic, and the effect of positive ions is negligible, the conduction of current is governed, over a certain range, on the one hand by the effect of the impressed voltage, which tends to propel the electrons across the vacuous space, and on the other hand by the mutual propulsion of the electrons in the space, which tends to limit or inhibit the current. This last mentioned phenomenon, the current limiting effect of the electric field of the electrons on each other, termed the "space charge effect," is discussed and analyzed by me in a paper read before the Physical Society on October 18, 1913, which was abstracted in the Physi-

cal Review for November, 1913, and published in full in the Physical Review for December, 1913, and again published in somewhat modified form in the Physikalische Zeitschrift for April 1, and May 15, 1914. It is the basis of the 3/2 power law referred to herein.

The geometric proportions of the device also affect the amount of current which will pass with a given voltage, but as these conditions remain fixed for a given device they may be represented by a constant in an equation expressing the relation between the current and the voltage.

As stated above, the current (I) in the particular device described herein, when operating below saturation, will vary with the 3/2 power of the voltage (V), the equation being:

$$I = sV^{3/2}, \text{ (s being a constant)}$$

As is well known, if we produce a logarithmic graph of any equation in which one variable of the equation varies as a power of the other variable, as for example, an equation of the general form $y=x^n$, (as by plotting logarithms of x as abscissæ and logarithms of y as ordinates) we find that this graph is a straight line. Hence the relation between current and voltage in a device operating below saturation and by pure electronic conduction independent of gas ionization may be expressed by the statement that when with a sufficient electron emission the logarithms of the current values transmitted between cathode and anode are plotted as ordinates against the logarithms of the respective voltages impressed between cathode and anode as abscissæ, the slope of the line obtained does not ordinarily increase for increasing voltage values over a working range of voltages extending materially above the ionization voltages.

A substantial amount of positive ionization ordinarily causes the logarithmic plot of the current with respect to the voltage to bend upwardly and away from the 3/2 power line when the ionizing voltage is materially exceeded. The absence of a bend in the logarithmic plot at voltages somewhat above the ionization voltage is ordinarily a reliable indication that the tube is a pure electron discharge tube, though saturation complete or partial at voltages somewhat greater than the ionization voltages may prevent such a bend in the plot of an ionizing tube.

As above indicated, one of the indications of positive ionization is the occurrence of erratic readings in measuring devices connected in circuit with an electron discharge device under observation. Such erratic readings, of course, will produce a sudden change or discontinuity in the logarithmic graph plotted as above described, and any such irregularities will be more manifest when observed as deviations from a straight line than when the readings are plotted directly.

The effect of positive ionization upon the magnitude of the discharge is especially marked in that region of operation where the current is limited by the space charge effect already discussed, and changes in curvature of the discharge characteristics may occur as indicated unaccompanied by any visible evidence of ionization such as blue glow or the like. At saturation on the other hand, the discharge is ordinarily much less sensitive, and in fact the discharge may actually exhibit marked blue glow effects along with a flat or straight saturation curve.

Devices made in accordance with my invention may be used for various technical purposes, such as relaying and detecting currents, producing oscillations and rectifying alternating currents, and such devices may be made which will operate without substantial positive ionization at voltages far above the ionization voltages with currents thousands of times greater than the currents at which the devices of the prior art were operable without substantial positive ionization. Devices made and operated in accordance with my invention are capable of transmitting currents materially exceeding one-tenth of a milliampere without causing positive ionization to take any essential part in the operation of the device, though the voltage is materially above the ionization voltages.

Before describing the method of preparing my new type of apparatus, I will describe the structure of the apparatus illustrated by Figs. 1 to 3.

As shown in Fig. 1 the various parts of the apparatus may be mounted in a tube, or envelope 1, upon a pedestal 2, similar to the mount used in incandescent lamps. The cathode 3 is centrally located and may consist of a short straight filament not shown in Fig. 1, but indicated by the position of terminals 5, 6, and shown plainly in Fig. 3. The cathode shown in Fig. 2 consists of a V-shaped conductor. Either form may be used, the particular form of cathode being ordinarily determined by convenience of construction. Preferably the cathode conductor is held taut by a spring 7 to avoid contact of the cathode conductor with the grid by sagging when the metal is expanded at a high temperature. The filament 3 is mounted between two oppositely disposed supports, 9, 9', in this case constituting a closed loop, which may consist of insulating material, such as glass or quartz, but in some cases may to advantage consist of metal. Upon this frame-work is wound a discharge-varying conductor 10, ordinarily called a grid. The turns of the wire are closely adjacent to each other and are also very closely

adjacent to but are out of contact with the incandescent cathode. By means of this grid 10 potential may be applied to exert a static control upon the movements of the electrons. A negative potential applied on the grid reduces the flow of current from cathode to anode in proportion to the degree of negative charge. A positive grid potential assists and directs the flow of current from cathode to anode in proportion to the degree of its charge.

The supporting framework for the cathode and grid is attached to a rod 11, mounted upon the stem of the tube. Adjacent to the cathode and grid is the anode 12 which in the present case has been indicated as consisting of a wire strung in a zig-zag manner over hooks 13 upon fork-shaped supports 14 and 15, but it is not necessary that it should assume this particular form. Both anode and grid preferably consist of tungsten, but other refractory metals may be used. By constituting the anode a continuous conductor it can be conveniently heated by passage of current during evacuation of the device and for this purpose is attached to leading-in conductors 16 and 17. The grid is indicated in Fig. 1 as being attached to leading-in conductors 18 and 19 at opposite ends, although but one terminal is ordinarily necessary.

In some cases it is desirable to use a plate-shaped anode; Fig. 2 illustrates such an arrangement suitable particularly for rectifying alternating current. The tube itself and other extraneous parts have not been shown in Fig. 2, as they are similar to Fig. 1. The cathode construction has already been referred to and the anodes 20 and 21 also preferably consist of tungsten and may be connected electrically with each other. Current connections are made by conductors 22, 23, the supports 24, 25 being merely indicated. It will be noted that both in Figure 1 and Figure 2 the electrons are afforded a short and direct path from the cathode to the anode and that this path is so related to the position of the walls of the tube as to minimize the tendency for electrons to pass to the walls of the tube. In such a tube electron bombardment of the walls of the tube is avoided, together with the heating of such walls and the secondary emission of electrons therefrom which said bombardment causes. The energy of the discharge is delivered mainly, or entirely, at the anode, anodes, or upon other interior members in stead of at the walls of the tube.

For the evacuation of the device the glass walls of the tube are carefully heated to as high a temperature as the glass will stand without softening and in general the most approved methods of incandescent lamp exhaust are used. The evacuation of the tube preferably while still heated is carried out by means of a suitable evacuating means, for example, a Gaede molecular pump, which removes vapors as well as gases. Chemical evacuating means such as electrically vaporized calcium or magnesium may also be used. Either before or during the evacuation the anodes may be heated, especially when the anodes are to be run at elevated temperature during the normal operation of the device. In this case the temperature is preferably carried close to brilliant incandescence. In the case of the structure shown in Fig. 1, the heating may take place by passing an electrical current through the wire 12. The heating, especially of solid anodes such as shown in Figure 2, may take place in a suitable vacuum furnace, the temperature preferably being raised to 2,500° C. or even higher. Bombardment is a very effective means of removing occluded gas from anodes.

The bombardment is carried out when the evacuation has proceeded to a high degree by applying a potential between the cathode 3 and the anode 12, Fig. 1, the value of which depends upon the character of the device. Care should be taken to use a voltage below that at which a blue glow appears as this indicates harmful gas ionization, and as already pointed out, sputtering and disintegration of the cathode accompanies or closely follows the blue glow phenomenon. The pump should be constantly operated to remove the gas. After the removal of the gas thus driven out the voltage impressed between the cathode and the anode, or anodes, as the case may be, is increased thereby driving out more gas. This process is continued step by step with a progressively higher voltage, the final voltage depending upon the character of the apparatus. In most cases the final voltage should be materially higher than the voltage at which the device is to be used in actual service. However, in the case of devices that use exceedingly high voltages, such as 50,000 volts or even higher, substantially all the gas may be removed from the anode without resorting to voltages higher than the normal operating voltage. In the case of a plate-shaped anode which cannot be readily heated by passage of current, the discharge voltage may be chosen great enough to convey sufficient energy to the anode to raise its temperature to redness or even higher, when the device is to be used with a discharge current adapted to heat the anodes.

After the metal has been freed from occluded gas reabsorption of gas will not readily take place even though it is exposed to the air or other gases. For example, anodes thus treated may be removed to other apparatus which then may be evac-

ated with less electron bombardment of the anode or anodes.

The evacuation of the device should be preferably carried to a pressure as low as a few hundredths of a micron, or even lower, but no definite limits can be assigned. The residual gas pressure should be below the value at which ionization by collision will take place at the given working voltage and current, with its accompanying phenomena of blue glow, disintegration of the cathode, and so forth. When the cathode and anode are located in close proximity and the discharge confined to the region between the same, the permissible pressure is higher than when the cathode and anode are at some distance. It is also true that when the anode has been carefully freed from gas, residual free gas, even if present in a sufficient amount to cause some gas ionization when the apparatus is first started, does little harm, as it is quickly removed by the gas clean-up effect when the device is operated.

Electron discharge apparatus thus provided with a gas-free pretreated anode or anodes, may be constructed to handle currents at a very high voltage by proper mechanical design of the parts subjected to static strains, suitable proportioning of the parts and so forth as described, for example, in my application Serial No. 795,609 filed concurrently herewith upon which Patent 1,273,783 was granted on July 23, 1918.

The asymmetric conductivity existing between the heated and unheated electrodes of a device of the character described may be utilized for various technical purposes. Reference has already been made to the rectification of current. As shown in Fig. 4, an electron discharge tube may be used for detecting electromagnetic waves in radio-telegraphy. As shown in this Fig. the grid g and heated cathode c of an electron discharge tube 26 are connected respectively to the terminals of the secondary of a transformer 27, the primary of which is included in the antenna circuit 28. The antenna is grounded through a condenser 29 in the usual manner. The cathode c is heated by a local source of energy, as battery b. A battery 30 in the grid circuit 31 has its negative terminal connected to the grid g. A condenser 32 shunts the secondary of the loosely coupled transformer 27. The inductance of the transformer and the capacity of the condenser are adjusted to make the receiving circuit resonant to the frequency of the oscillations to be received. The oscillations set up by the incoming signals are superimposed upon the negative grid potential and causes a variation of current transmitted between cathode c and anode a by a local source of energy such as a battery 33 included in the local or plate circuit 34, 35, of the discharge tube. This circuit is connected to an ordinary telephone receiver 36, preferably shunted by means of a condenser 37, whereby the signals are detected.

Fig. 5 illustrates how an electron discharge tube may be used in a system for producing alternating current from direct current. The anode a and cathode c are connected respectively to conductors 38, 39, one of which includes a local source of energy, such as a battery 40. The terminals of these conductors are connected to an inductive coil 41. The cathode and grid g are also connected respectively by conductors 39 and 42 to a second inductive coil 43 which may be in a variable inductive relation to the coil 41. As soon as a flow of current starts in the plate circuit 38, 39, current is induced in the coil 43 of the grid circuit 39, 42. When by reason of this current the grid becomes negatively electrified, the flow of current in the plate circuit is reduced, and as the plate current decreases the grid electrification changes to positive, which again allows the current in the plate circuit to increase. These changes take place with a frequency depending on the electrical characteristics of the circuits. Across the grid circuit 39, 42, of the discharge tube, in some cases is connected a condenser 44, the capacity of which may be varied to control the frequency of the oscillations set up by the system. The oscillations may be transformed to higher or lower voltage by a transformer coil 45 to the terminals of which are connected transmitting conductors 46, 47. The system shown in Fig. 5 is described and claimed in a copending application, Serial No. 797,967, filed October 29, 1913.

Residual gas left in a tube when it is sealed off or occluded gas driven off from the inner wall of the tube, or from the electrodes, during the use of the tubes, varies in pressure from time to time according to the conditions of operation of the tube and may produce irregularities in the discharge when operating in the saturation region as well as when operating below saturation. The irregularities below saturation are due mainly to the disturbing effect of the resulting positive ions upon the space charge. The irregularities in the saturation region are due to changes in the rate of emission or liberation of electrons at the cathode. It is obvious that the advantages of stable and reproducible operation and freedom from destructive bombardment of the cathode by positive ions, which advantages are severally or collectively to be secured by the means hereinabove described, are not limited to operation below saturation but are also important in operation in the saturation region.

The positive ionization herein referred to is that positive ionization which occurs as the result of collisions between electrons and gas molecules in the space between the electrodes and causes, as by producing changes in space charge, unstable and non-reproducible operation.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the governing or limiting action on the space current due to the electric field of said electrons is substantially unaffected by positive ionization and by secondary electron emission from the walls of the tube.

2. A discharge tube having a cathode adapted to emit electrons and an anode adapted to receive said emitted electrons, the tube walls being fashioned or shaped to permit the direct passage of a useful proportion of said electrons from cathode to anode, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the space current is governed or limited by the electric field of said electrons substantially unaffected by positive ionization.

3. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that in that range the space current is governed by the combined effect of the electric field of said electrons and the potentials applied to said electrodes, the governing or limiting of the current being substantially unaffected by positive ionization and by secondary electron emission from the walls of the tube.

4. A discharge device comprising a tube and electrodes therein one of which is adapted to emit electrons, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed upon electrodes of the device and when the electron emission has any value such that the space current is below the saturation region at such voltages, that the slope of the line obtained by plotting the logarithms of values of said current as ordinates against the logarithms of the corresponding values of said impressed voltages as abscissæ shows no increase for increasing voltage values.

5. A discharge device comprising a tube and electrodes therein one of which is adapted to emit electrons, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the device and when the electron emission has any value such that the space current is below the saturation region at such voltages, that the line obtained by plotting the logarithms of any values of said current below the saturation region as ordinates against the logarithms of the corresponding values of said impressed voltages as abscissæ is straight and continuous.

6. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the tube and when the electron emission has any value such that the space current is below the saturation region at such voltages, that said current varies as the three halves power of said impressed voltages.

7. A discharge device comprising a tube and electrodes therein one of which is an electron emitting cathode, the degree of evacuation of said device and the relation of the parts of the device being such that the device is capable of being so operated, when voltages materially higher than ionization voltages are impressed on electrodes of the device and when the electron emission is such that the space current is below the saturation region at such voltages, that said current is substantially independent of the cathode temperature and unaffected by secondary electron emission from the walls of the tube.

8. A discharge tube having electrodes at least one of which is adapted to emit electrons, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of being so operated in a range below saturation and materially above ionization voltages that the space current is governed or limited by the combined effect of the electric field of said electrons and the potentials applied to said electrodes, substantially unaffected by positive ionization, the heating effect in the tube due to said current occurring substantially only at one or more of said electrodes.

9. A discharge tube having a cathode adapted to emit electrons, an anode adapted to receive electrons and tube walls fashioned or shaped so as to permit the free passage

of a useful proportion of said electrons from cathode to anode, the gas content or residue of said tube and the relation of the parts of the tube being such that the tube is capable of operation with stable and reproducible results substantially unaffected by positive ionization, with currents of at least 5 milliamperes and with voltages of at least 200 volts.

10. An electrical discharge device comprising a gas-tight envelope, an electron-emitting cathode, a cooperating anode, and a discharge-varying conductor, the space in said envelope being evacuated to below the pressure at which deleterious gas ionization takes place, constituting a device in which the current passed when operated below saturation and over a working range of voltage materially above the ionization voltages is controlled by space charge substantially unaffected by positive ionization.

11. A high vacuum electron discharge device comprising an envelope, an incandescent cathode, and an anode, the space in said envelope being evacuated to such degree that the passage of current produces no appreciable positive ionization when the impressed voltage is as high as 200 volts

12. An electrical discharge device, comprising a gas-tight envelope, an electron emitting cathode, an anode deprived of ionizable gas and a discharge controlling conductor, the space in the envelope being evacuated to a pressure not substantially in excess of a few hundred thousandths of a millimeter of mercury, said device being characterized by the fact that when operated below saturation and materially above the ionization voltages, the current is controlled by space charge substantially unaffected by positive ionization.

13. An electrical discharge device comprising a gas-tight envelope, an electron emitting cathode, a cooperating anode, the space and materials in said envelope being sufficiently free of gas so that substantially no positive ionization occurs when the impressed voltage is as high as 60 volts, and the current over a working range of voltage up to 60 volts varies with the 5/2 power of the impressed voltage.

14. An electrical discharge device comprising a gas-tight envelope, a cathode adapted to be heated to incandescence, an anode from which substantially no ionizable gas can be evolved at operating voltages up to 100 volts with currents up to 1 milliampere, the envelope so shaped and the electrodes so positioned as to substantially avoid secondary electron emission from the wall of the envelope, the space in said envelope being evacuated to a pressure not in substantial excess of a few hundred thousandths of a millimeter of mercury.

15. A device comprising a gas-tight envelope, a cathode adapted to be heated to incandescence, an anode from which no ionizable gas can be evolved at operating voltages up to about 200 volts with operating currents up to about five milliamperes, the space in said envelope being evacuated at a pressure not in substantial excess of a few hundred thousandths of a millimeter of mercury, said device being characterized by the fact that with currents up to about five milliamperes at voltages up to about 200 volts, evidences of positive ionization are substantially absent and the current over a working range below saturation varies with the 3/2 power of the voltage.

16. An electrical discharge device comprising a sealed envelope, an incandescent cathode, and a tungsten anode, said anode deprived of ionizable gas disengageable by electron bombardment, and the space in said envelope being evacuated to a sufficiently low pressure so that current flow produces substantially no phenomena of positive ionization when the impressed voltage is as high as 100 volts and the current is as large as 1 milliampere, and the energy of the discharge is delivered mainly upon said anode.

17. An electron discharge apparatus comprising an envelope, an electron emitting cathode, and an anode, said anode being free of gas disengageable by electron bombardment and said envelope being sufficiently free of gas, so that conduction of current can take place in the evacuated space independently of gas ionization at voltages materially above the ionizing voltages with currents of more than one-tenth of a milliampere, and with the energy of the discharge delivered mainly at said anode.

18. An electrical discharge device comprising a sealed envelope, a cathode, means for producing emission of electrons at said cathode independently of the operating voltage, an anode, and discharge varying means independent of the cathode and anode, said device being freed from gas to such extent that the same is operable to transmit current at an impressed voltage at least as high as about 200 volts without evidences of substantial positive ionization.

19. An electrical discharge device comprising a sealed envelope, an incandescent cathode, an anode and discharge-varying means independent of the cathode and anode, the gas residues in said device being so small that the conduction of current is stable and reproducible over a range of voltage materially above the ionization voltages with currents in excess of one milliampere and with the energy of the discharge delivered mainly upon electrodes.

20. An electrical device comprising the combination of a sealed evacuated envelope, a cathode adapted to be independently heated, and an anode within said envelope,

an external circuit connected to said electrodes, and a source of electro-motive force applied to said circuit, the degree of vacuity and the electron emission of the cathode being so related to the potential of said source that the flow of current over a range of voltage materially above the ionization voltage is governed by the electric field of the electrons in the vacuous space and the potential applied to said electrodes, operatively independent of gas ionization.

21. Apparatus for controlling an electric current comprising a vacuum tube, an anode and an electron emitting cathode in the circuit of said current and within said tube, the degree of evacuation of the tube and the relation of its parts being such that for voltages materially above ionization voltage the current is governed or limited by the electric field of the electrons in said tube substantially unaffected by positive ionization, and a third electrode in said tube by which an auxiliary controlling electromotive force may be superposed to modify the effect of said electric field and control said current in a stable and reproducible manner.

22. The method of controlling an electric current in one circuit by an electromotive force in another circuit which consists in causing said current at voltages materially above ionization voltages to pass as a discharge across a vacuous space between an electron emitting cathode and an anode, maintaining a high vacuum in said space, governing or limiting the current by a space charge effect in said space substantially unaffected by positive ionization, and superimposing the effect of said electromotive force on said space charge effect to control said current in a stable and reproducible manner.

23. A discharge device comprising a tube and electrodes therein, one of which is a cathode, the discharge passing in the main directly between electrodes, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated below saturation and at voltages materially higher than the ionization voltages, that the slope or location of the logarithmic line of current with respect to voltage is not changed by changes in the temperature of the cathode.

24. A discharge device comprising a tube and electrodes therein, one of which is a cathode adapted to be heated and to emit electrons thereby, the discharge passing directly between electrodes, the degree of evacuation and the relation of the parts of the device being such that the device is capable of being so operated below saturation and at voltages materially higher than the ionization voltage, that the plot of the current against the voltage is not changed with changes in the temperature of the cathode.

25. A discharge device comprising a sealed off envelope having therein a cathode adapted to be heated independently of the discharge and to deliver electrons thereby, and an anode, the inner wall of the envelope and the electrodes being sufficiently free of occluded gas, and the free gas within the envelope being such, so that the finished device is capable of sustained operation below saturation in a stable and reproducible manner with currents of more than one milliampere at voltages materially higher than the ionization voltages and with the energy of the discharge delivered mainly at an electrode or electrodes.

26. A discharge device comprising a sealed off envelope and electrodes therein, the envelope being shaped and the electrodes located so that the energy of the discharge is delivered mainly upon one or more of the electrodes, the inner wall of the envelope and electrodes being so free from occluded gas and the pressure in the tube being sufficiently low, with respect to the spacing of the electrodes and the energy of the discharge, so that the device is capable of passing a sustained discharge of one tenth of a milliampere at forty volts, without developing any substantial positive ionization effects.

27. A discharge device comprising a sealed off envelope and electrodes therein, one of which is a cathode adapted to be heated independently of the discharge and to emit electrons thereby, the inner wall of the envelope and the electrodes being so free from occluded gas that the device is capable of passing a sustained discharge of one milliampere at fifty volts with the energy of the discharge delivered mainly at an electrode or at electrodes without liberating any substantial amount of gas into the space within the envelope.

28. A discharge device comprising a sealed-off envelope and electrodes therein, one of which is a cathode adapted to be heated independently of the discharge and to emit electrons thereby, the inner wall of the envelope and the electrodes being so free from occluded gas that the device is capable of passing a sustained discharge of two milliamperes at one hundred volts with the energy of the discharge delivered mainly at an electrode or at electrodes without liberating any substantial amount of gas into the space within the envelope.

29. An electrical discharge device comprising a gas-tight envelope, a cathode adapted to be heated to incandescence, an anode from which substantially no ionizable gas can be evolved at operating voltages up to forty volts with currents up to one-tenth milliampere, the envelope so shaped and the electrodes so positioned as to substantially avoid secondary electron emission from the wall of the envelope, the space in said en-

velope being evacuated to a pressure not in substantial excess of a few hundred thousandths of a millimeter of mercury.

30. In the process of producing a discharge device, removing the occluded gas from the interior surface of the envelope thereof and from the electrodes to such an extent that the finished sealed-off device will operate, without liberating any substantial amount of gas into the space within the envelope, at voltages materially above the ionization voltage with currents greater than one milliampere and with substantially all the energy of the discharge delivered to an anode or anodes.

31. In the process of producing a hot cathode discharge device, treating the interior surface of the envelope and the operating parts to liberate therefrom occluded gas, and removing from the envelope gas liberated by said treatment and free gas originally contained therein, continuing these operations until the occluded and original free gas is so thoroughly removed as to enable the finished sealed-off device to operate below saturation in a stable and reproducible manner at a voltage above fifty volts and with a current greater than one milliampere and with the energy of the discharge delivered mainly at one or more anodes.

32. The process of producing a discharge device which consists in treating the envelope and enclosed parts thereof to liberate gas therefrom and removing from the envelope gas which is thereby liberated and free gas originally contained in the envelope, the treatment being sufficiently powerful and being sufficiently prolonged and the removal of the liberated and original free gas from the envelope being sufficiently thorough, so that the finished sealed-off device is capable of sustained operation substantially without positive ionization at voltages as high as one hundred volts with currents as great as one milliampere and with substantially the entire energy of the discharge delivered upon the anode or anodes of the device.

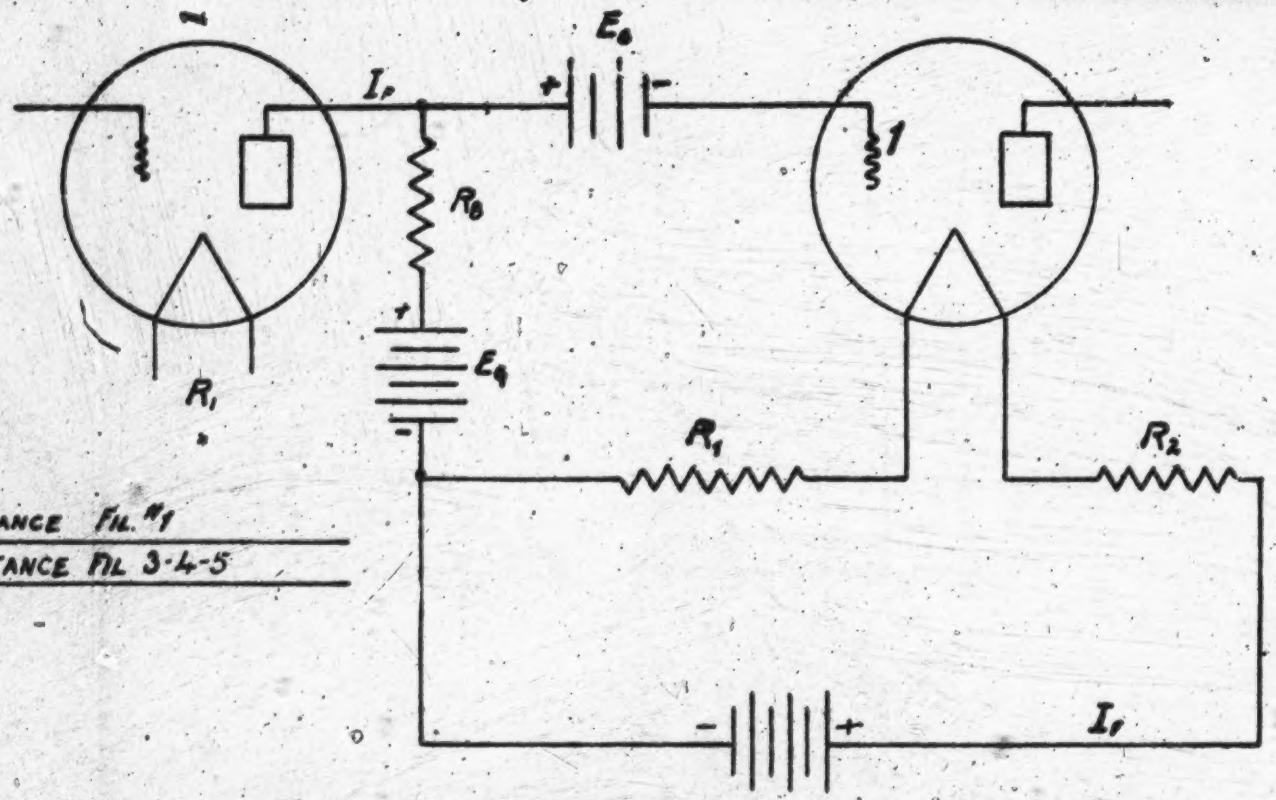
In witness whereof, I have hereunto set my hand this 15th day of October 1918.

IRVING LANGMUIR.

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Deft's Ex. G (Cited as to Mathes 1,426,754)



R_1 = RESISTANCE FIL. #1

R_2 = RESISTANCE FIL 3-4-5

$E_c = E_g - (E_g + R_b I_p + R_1 I_f)$

FIG 2 ARNOLD 1129943

FIG 5 ARNOLD 1129942

DEFENDANT'S EXHIBIT G

1560

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PAGE

DEFENDANT'S EXHIBIT H

1561

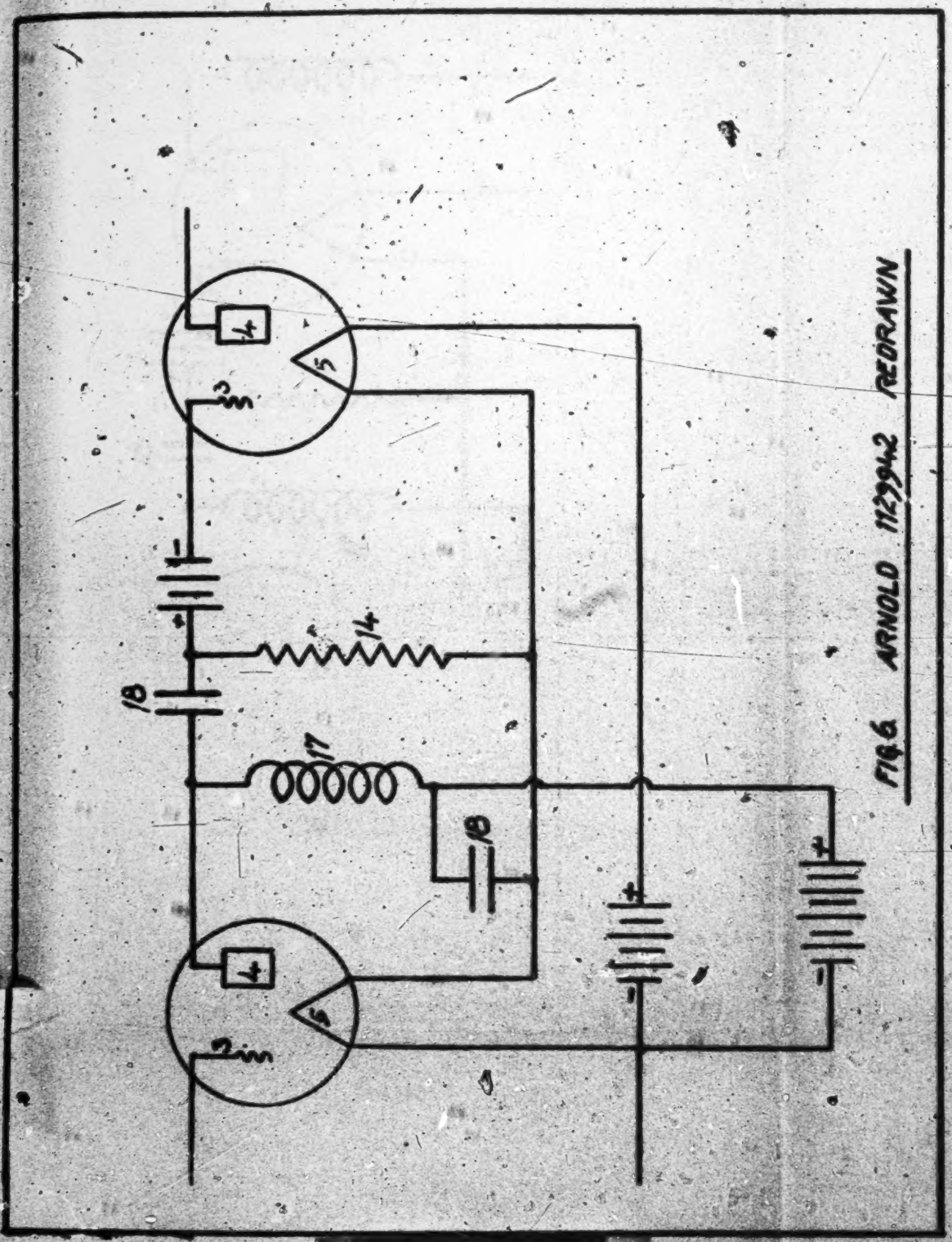


FIG 6 ARNOLD 1129942 REDRAWN

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PAGE

DEFENDANT'S EXHIBIT 1

1562

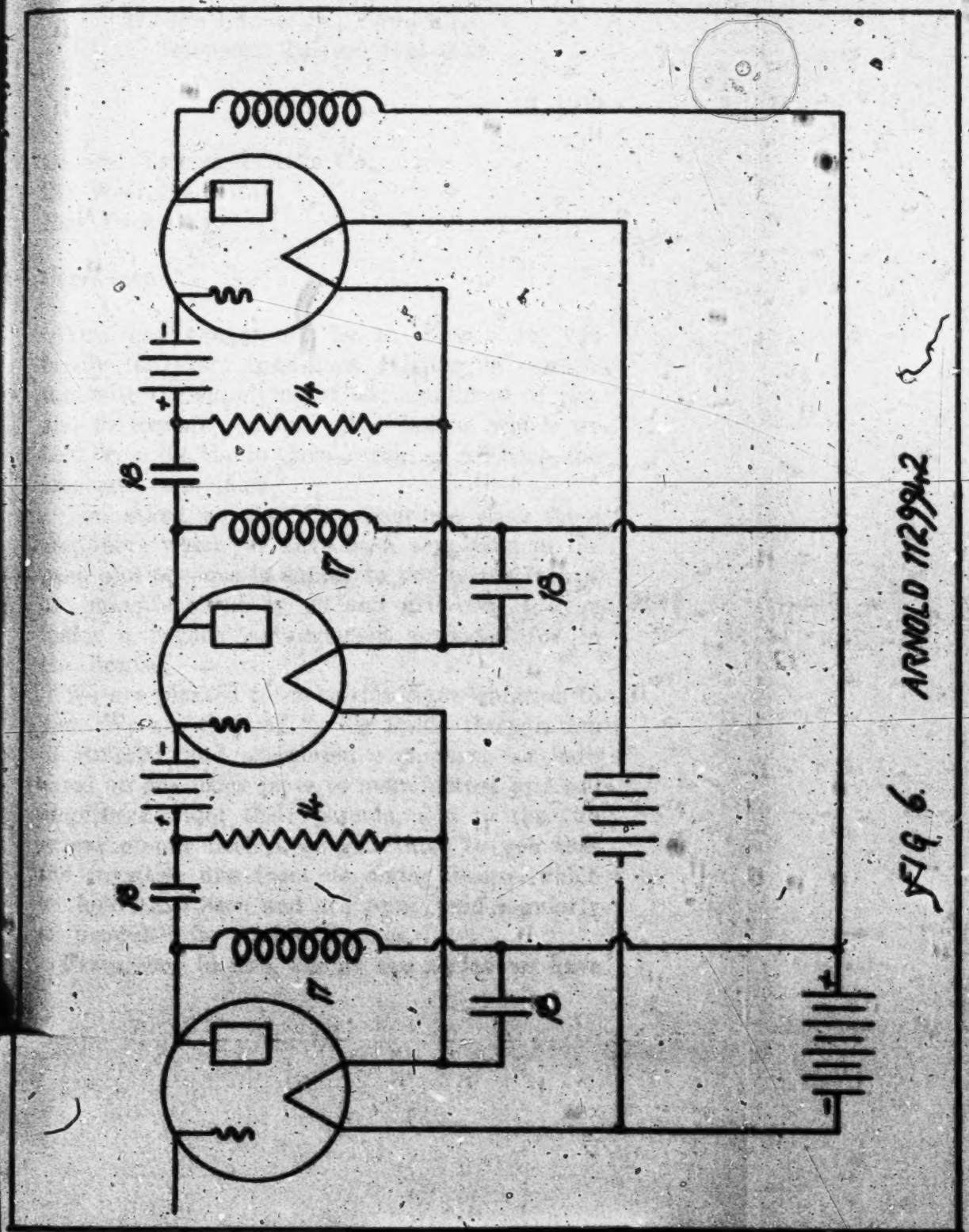


FIG. 6. ARNOLD 11/29/42

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4687

Defendant's Exhibit J.

AMERICAN TRANSFORMER COMPANY
MAKERS OF ELECTRICAL APPLIANCES
172-188 Emmet St., Newark, N. J.
Telephone Terrace 4444-4445

July 16, 1929

General Talking Picture Co.,
218 West 42nd St.,
New York City.

4688

Gentlemen:

You have requested us to outline to you briefly the exact conditions existing in connection with the supplying of our amplifiers to you, and to explain generally the license which we hold from the Radio Corporation of America and associate companies.

You asked us also for assurance that these amplifiers which we have been supplying in the past, and propose to supply to you in the future, are manufactured by us and delivered to you 4689
under a royalty arrangement provided for in the license.

We are pleased to make this representation to you. We are licensed by the Radio Corporation of America and associated companies, as indicated on our name plate to manufacture and sell amplifiers under their patents, and to the full extent of our license we guarantee to you that the royalties due from us under license which we hold have been and are being paid regularly as provided for in the licenses.

From time to time during the period we have

been supplying our amplifiers to you, we have had interviews with a Representative of the Western Electric Company, in which it was mentioned that we had been supplying these amplifiers freely to you and others and no question has been raised as to our right to make such sales. As a matter of fact, our books are open to inspection by the Radio Corporation of America and they are fully aware of the fact that we are dealing with you and they have raised no
4691 objection whatsoever.

We have been informed that a Representative of the Western Electric Company has examined one of these amplifiers which you had installed in a theatre, and as to that particular amplifier he stated that it appeared to be a very high grade product.

In view of the foregoing, we are quite prepared and do hereby undertake to continue to supply you with as many amplifiers as you may in reason require from time to time during the term of our present license, and particularly in
4692 view of your contemplated larger orders, you are entitled to our specific undertaking not to discontinue for any reason whatsoever other than non-payment of moneys due us if any.

We hereby give you an option to order from us two thousand (2,000) amplifiers, on the same terms and conditions as amplifiers have been heretofore supplied to you. The price to be mutually agreed upon. The period of said option to continue for one year from the date hereof and said amplifiers to be furnished and supplied as promptly as reasonably can be done.

Provided you shall have fulfilled all the terms

Defendant's Exhibit K. 4693

and conditions of the order during such one year period, we hereby grant you an option for another year provided we have a license upon the same term as at present to manufacture such amplifiers.

Very truly yours,

AMERICAN TRANSFORMER COMPANY
CHAS. F. LOUGHEAD
President. 4694

Defendant's Exhibit K.

AMERICAN TRANSFORMER COMPANY
MAKERS OF ELECTRICAL APPLIANCES
172-188 Emmet St., Newark, N. J.

Telephone Terrace 4444-4445

July 24th, 1929

4695

General Talking Pictures Corp.,
218 West 42nd Street,
New York City.

Gentlemen:

You have requested us to outline to you briefly the exact conditions existing in connection with the supplying of our amplifiers to you, and to explain generally the license which we hold from the Radio Corporation of America and Associated companies.

You asked us also for assurance that these

4696 *Defendant's Exhibit K.*

amplifiers that we have been supplying in th
past and propose to supply to you in the futu
are manufactured by us and delivered to yo
under a royalty arrangement provided for i
the license.

We are pleased to make this representation t
you. We are licensed by the Radio Corporatio
of America and associated companies, as ind
cated on our name plate, to manufacture an
sell amplifiers under their patents, and to th
4697 full extent of our license we guarantee to ye
that the royalties due from us under licens
which we hold have been and are being pai
regularly as provided for in the licenses.

From time to time during the period we hav
been supplying our amplifiers to you, we hav
had interviews with a representative of th
Western Electric Co. in which it was mentione
that we have been supplying these amplifier
freely to you and others and no question ha
been raised as to our right to make such sale
As a matter of fact, our books are open to in
4698 spection by the Radio Corporation of Americ
and they are fully aware of the fact that we ar
dealing with you and they have raised no ob
jection whatsoever.

In view of the foregoing, we are quite pre
pared and do hereby undertake to continue t
supply you with as many amplifiers as you ma
in reason require from time to time during th
term of our present license, and particularly i
view of your contemplated larger orders, yo
are entitled to our specific undertaking not t
discontinue for any reason whatsoever other tha
non-payment of moneys due us if any.

Defendant's Exhibit K. 4699

We hereby give you an option to order from us two thousand (2,000) amplifiers on the same terms and conditions as amplifiers have been heretofore supplied to you and the period of said option to continue one year from the date hereof; and we hereby grant you a continuing option from year to year during the term of which we have license to manufacture such amplifiers, provided you shall have fulfilled all the terms and conditions of each preceding year, and we agree on our part not to mutually arrange with the 4700
licensor under whom we manufacture, to cancel such license. We agree to exercise full reasonable care and diligence to make deliveries on your orders as required so far as possible within reasonable manufacturing practice.

AMERICAN TRANSFORMER COMPANY
CHAS. F. LOUGHRAD
President

4701

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DEFENDANT'S EXHIBIT L

1568

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPARATUS

172-186 EMMET ST., NEWARK, N. J.

Telephone 4001-4005

July 26, 1929

Mr. Chas. J. Ross, Comptroller,
Radio Corporation of America,
233 Broadway,
New York City.

Dear Sir:

We are enclosing our check for $8825.45 same being Royalty due for material sold during the second quarter of this year as per attached statement.

We trust you will find this correct, and remain

Very truly yours,

AMERICAN TRANSFORMER COMPANY.

Chas. L. Loughlin
Pres.

Encl. 2

7/27/9

133

1569

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-188 EMMET ST., NEWARK, N. J.

TELEPHONE NUMBERS | 2116 2117

REPORT SECOND QUARTER 1929

APRIL - MAY - JUNE

1929

	MODEL #1	MODEL #2	MODEL #5	MODEL 8	MODEL #8	MODEL 17
April 1st	6	4	1	-	-	-
2d	-	-	-	2	-	-
3d	-	-	-	-	-	-
4th	-	-	-	2	-	-
5th	-	-	-	-	-	-
6th	-	-	-	-	-	-
7th	-	-	-	-	-	-
8th	-	1	-	-	-	-
9th	1	1	-	2	-	-
10th	1	1	-	1	-	-
11th	-	-	-	4	-	-
12th	-	-	-	5	-	-
13th	-	-	-	-	-	-
14th	-	-	-	-	-	-
15th	-	-	-	1	-	-
16th	-	-	-	-	-	-
17th	-	-	-	-	-	-
18th	2	1	-	2	-	1
19th	-	-	-	4	-	-
20th	-	-	1	9	-	-
21st	-	-	-	-	-	-
22d	-	-	-	-	-	-
23d	5	4	-	-	-	-
24th	-	-	-	5	-	-
25th	-	-	-	-	-	-
26th	-	-	-	5	-	-
27th	-	-	-	5	-	16
28th	-	-	-	-	-	-
29th	-	-	-	1	-	-
30th	-	-	-	-	-	-
31st	-	-	-	-	-	-
Total ---	15	12	2	46	-	17

Apr. 23- Spec. Amplifier

Total to be Deducted from Sales -

116 - $13377 @ 2.00 less, less 50.10% = $1161.60

13-1

AMERICAN TRANSFORMER COMPANY
MAKERS OF ELECTRICAL APPLIANCES
172-186 EMMET ST., NEWARK, N. J.
TELEPHONE THOMAS | 4444 4445

1929

	MODEL #1	MODEL #2	MODEL #5	MODEL #6	MODEL #8	MODEL #7
May 1st	-	-	-	6	-	13
2d	-	1	-	-	-	-
3d	-	-	-	-	-	-
4th	-	-	-	-	-	-
5th	-	-	-	-	-	-
6th	-	-	-	-	-	-
7th	-	-	-	-	-	16
8th	-	-	-	-	-	8
9th	-	-	-	7	-	-
10th	-	-	-	-	-	20
11th	-	-	-	-	-	-
12th	-	-	-	-	-	-
13th	1	-	-	8	-	10
14th	1	-	-	-	-	1
15th	-	1	-	-	-	-
16th	-	-	-	-	-	6
17th	2	2	-	-	-	-
18th	-	-	-	-	-	-
19th	-	-	-	-	-	-
20th	-	-	-	-	-	-
21st	-	-	-	5	-	8
22d	1	-	-	-	-	7
23d	-	-	-	-	-	-
24th	-	-	-	1	-	1
25th	-	-	-	-	-	-
26th	-	-	-	-	-	-
27th	1	1	-	10	-	7
28th	1	1	-	-	-	-
29th	-	-	-	-	-	1
30th	-	-	-	-	-	8
31st	-	-	-	4	-	8
Total---	7	6	-	41	-	85

May 18th - Spec. Amplifier

32	Model	#1	@ $36.00	= $ 1152.00
1	"	#1	@ $22.40	= 22.40
29	"	#2	@ $37.00	= 1065.00
1	"	#2	@ $31.50	= 31.50
5	"	#2	@ $21.60	= 108.00
104	"	#5	@ $425.	= 44200.00
2	"	#5	@ $648.	= 1296.00
5	"	#5	@ $550.	= 2750.00
5	"	#5	@ $625.	= 3125.00

135

Forward

1571

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-188 EMMET ST., NEWARK, N. J.

TELEPHONE, TYPEWRITER & CABLE

1924

	Model #1	MODEL #2	MODEL #3	MODEL #4	MODEL #5	MODEL #7	MODEL
June 1st	-	-	-	4	-	-	-
2d	-	-	-	-	-	-	-
3d	1	-	-	-	-	-	-
4th	-	-	-	-	-	-	-
5th	-	-	-	-	-	4	-
6th	-	-	-	-	-	-	-
7th	-	-	-	-	1	-	-
8th	1	-	1	-	-	-	-
9th	-	-	-	-	2	-	-
10th	-	-	-	-	-	-	-
11th	-	-	-	-	-	-	-
12th	-	-	-	-	2	12	-
13th	-	-	2	12	-	8	-
14th	-	-	-	-	-	-	-
15th	-	2	-	-	2	8	-
16th	-	-	-	-	-	-	-
17th	2	8	-	-	2	-	-
18th	2	2	-	-	-	-	-
19th	-	-	-	-	-	-	1
20th	-	-	-	-	-	14	-
21st	1	1	-	-	-	-	4
22d	-	-	-	-	-	-	-
23d	-	-	-	-	-	-	-
24th	-	-	-	-	-	6	-
25th	-	-	-	1	5	-	-
26th	-	-	-	-	-	-	-
27th	2	1	-	8	-	-	2
28th	1	-	-	8	1	-16	5
29th	2	2	-	-	-	6	3
30th	-	-	-	-	-	-	-
	15	18	3	33	15	72	15

13 Model #4 @ $225.00 = $ 2925.00

184 " #7 @ $ 60.00 = 11040.00

18 " #8 @ $ 40.00 = 800.00

Apr. 234 Spec. Amplifier 250.00

May 10th " " 250.00

Total

7 1/2% Royalty on [illegible] = [illegible]

amount of check we are attaching.

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-186 EMMET ST., NEWARK, N. J.

#11

Oct 26, 1929

Chas. J. Ross, Comptroller,
Radio Corp. of Am.,
233 Broadway,
New York City.

Dear Sir:

We are enclosing our check covering Royalties due for the third quarter of this year as per attached statement.

Below we give data as to just how this is arrived at:

8	Model	#1	@ $30.00	=	180.00
9	"	#2	37.50	=	313.00
1	"	#3		=	21.00
1	"	#3	Special	=	50.50
60	"	#4	@ $195.00	=	11760.00
10	"	#5	$411.00	=	4115.00
15	"	#5	405.00	=	6075.00
2	"	#5	488.00	=	975.00
19	"	#5	500.00	=	9500.00
1	"	#5		=	261.00
15	"	#6	225.00	=	3375.00
1	"	#7	Special	=	125.00
140	"	#7	@ $55.00	=	7700.00
74	"	#7	55.90	=	3968.60
18	"	#8	60.00	=	600.00
26	"	#8	240.00	=	6720.00
11	"	#8	265.00	=	2915.00
23	"	#8	@ $275.00	=	6325.00
6	"	#9	310.00	=	1860.00
1	"	#9	360.00	=	360.00
1	"	11		=	200.00
408					$97965.70

7 1/2% of $89478.10 = $6994.45 amount of check we are enclosing.

We trust you will find this correct, and remain,

Very truly yours,

AMERICAN TRANSFORMER COMPANY.

JLS-

Total to be Deducted from Sales

76- #13377 Less $78.00 Less 50.10% = $57.60

64- #13576 Less $240.00 " " = 576.00

$153.60

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-188 EMMET ST., NEWARK, N. J.

TELEPHONE NUMBER [illegible]

1924.	Model #1	Model #2	Model #5	Model #6	Model #7	Model #8	Model ?
July 1st	1	2	-	-	8	14	-
2d	-	-	-	4	-	-	-
3d	-	-	-	-	-	-	-
4th	-	-	-	-	-	-	-
5th	1	1	-	4	-	-	1
6th	-	-	-	-	10	-	-
7th	-	-	-	-	-	-	-
8th	-	-	-	6	-	-	-
9th	-	-	1	-	-	-	-
10th	-	-	-	-	-	-	-
11th	-	-	-	-	-	-	-
12th	1	1	-	2	-	-	-
13th	-	-	-	-	-	1	1
14th	-	-	-	-	-	-	-
15th	-	-	-	-	-	-	-
16th	-	-	-	-	-	-	-
17th	1	1	-	-	20	-	-
18th	-	-	1	-	-	-	-
19th	-	-	-	-	-	-	-
20th	-	-	-	-	-	-	-
21st	-	-	-	-	-	-	-
22d	-	-	-	-	6	-	-
23d	-	-	-	-	-	-	-
24th	1 returned	1 returned	12	-	-	-	-
25th	-	-	1	-	-	-	-
26th	-	-	-	-	-	-	-
27th	-	-	-	-	-	-	-
28th	-	-	-	-	-	-	-
29th	-	-	-	-	-	-	-
30th	-	-	-	-	20	-	3
31st	-	-	-	-	-	-	-
	5	4	15	16	64	15	5
	^	^	^	^	^	^	^

151 124

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-188 EMMET ST., NEWARK, N. J.

TELEPHONE NUMBER | 4224 3228

29

	Model #1	Model #2	Model #3	Model #5	Model #7	Model #9
1st	-	-	-	-	-	2
2d	-	1	-	-	-	-
3d	-	-	-	-	-	-
4th	-	-	-	-	-	-
5th	-	-	-	-	14	2
6th	-	-	-	-	-	2
7th	-	-	-	-	-	-
8th	-	-	-	-	-	3
9th	-	-	-	13	-	3
10th	-	-	-	-	8	-
11th	-	-	-	-	-	-
12th	-	-	-	-	-	-
13th	1	1	-	-	-	9
14th	-	-	-	-	-	-
15th	-	1	-	-	-	-
16th	-	-	-	-	6	-
17th	-	-	-	-	-	-
18th	-	-	-	-	-	-
19th	-	-	-	1	-	2
20th	1	1	-	-	-	1
21st	-	-	-	1	14	-
22d	-	-	-	-	8	-
23d	-	-	-	-	16	8
24th	-	-	-	-	-	-
25th	-	-	-	-	-	-
26th	-	-	-	-	12	10
27th	-	-	-	-	8	9
28th	-	-	-	-	-	-
29th	-	-	1	-	-	-
30th	-	1	-	-	-	-
31st	-	-	-	-	-	-
	2	5	1	15	88	56

130 163

1575

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-188 EMMET ST., NEWARK, N. J.

TELEPHONE TERMACE | 4644 4645

1929.

		Model #5	Model #6	Model #7	Model #9
Sept.	1st	-	-	-	-
	2d	-	-	-	-
	3d	-	6	20	-
	4th	-	-	-	-
	5th	-	15	12	-
	6th	-	-	10	-
	7th	-	-	6	-
	8th	-	-	-	-
	9th	-	5	-	-
	10th	-	-	-	-
	11th	-	-	-	-
	12th	-	-	-	-
	13th	-	-	11	-
	14th	-	-	-	-
	15th	-	-	-	-
	16th	-	-	-	-
	17th	-	-	-	-
	18th	1	-	-	-
	19th	-	-	-	-
	20th	-	-	-	-
	21st	-	-	-	1
	22d	-	-	-	-
	23d	-	-	-	-
	24th	-	-	6	5
	25th	-	-	-	5
	26th	-	-	-	-
	27th	-	[redacted]	-	-
	28th	-	-	-	-
	29th	-	-	-	-
	30th	-	11	-	-
	31st	-	-	-	-
		1	46	65	11

123
163
122
129 408

AMERICAN TRANSFORMER COMPANY
MAKERS OF ELECTRICAL APPLIANCES
172-188 EMMET ST., NEWARK, N. J.
TELEPHONE NUMBERS 4222 4223

Dec. 7th, 1929

Mr. Chas. J. Ross, Comptroller,
Radio Corporation of America,
233 Broadway, New York City.

Dear Sir:-

A revision of our cost system has revealed some slight errors in our report to you of October 26th covering the sales of amplifiers, and in which we enclosed our check amounting to $4994.43. This was based on the total sales for the third quarter amounting to $67925.70.

We are enclosing herewith the revised list of sales grouped according to months giving the names of the customers, billing prices, deductions for returned apparatus and cash discounts. There are individual sheets for July, August and September and a summary sheet totaling the net sales for the three months. This shows that the royalty which should have been paid amounts to $4902.47, and indicates that we paid in excess $91.96 which we are quite willing to have credited against sales for the last quarter of this year.

We trust that this correction is in order and that your records will agree with ours.

If we can be of any further service in this matter do not hesitate to call upon us.

Yours very truly,

AMERICAN TRANSFORMER COMPANY

J.L. Schermerhorn

J.L. Schermerhorn
Vice President

JLS/MS
Enc. 4 sheets

1577

AMERICAN TRANSFORMER COMPANY

MAKERS OF ELECTRICAL APPLIANCES

172-188 EMMET ST., NEWARK, N. J.

TELEPHONE TERMINAL [illegible]

GENERAL SUMMARY FOR JULY, AUGUST, & SEPTEMBER

MONTH	NET AMOUNT BILLED
July	$15,182.60
August	24,458.60
September	25,725.10
Total	$65,366.30
7½% Royalty	4,902.47

Royalty Actually Paid	$4,994.43
Amt. Royalty Corrected	4,902.47
Excess Royalty Paid	$ 91.96

Excess Royalty to be credited against last quarter 1929.

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-180 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tuxedo

JULY 1929 SALES

2nd	Gen. Talk.Pict. ✓	3	Model	#6	@ $225.	ea.	$ 675.00*
	" " " ✓	8	"	7	" 60.	"	480.00*
5th	" " " ✓	4	"	6	" 225.	"	900.00*
	" " " ✓	1	"	9	" 265.	"	265.00
2nd	Dr. I. Kitse	1	"	6	" 261.	"	261.00
5th	Gen.Talk.Pict. ✓	10	"	7	" 60.	"	600.00*
8th	" " " ✓	4	"	6	" 225.	"	900.00*
11th	Best Mfg. Co.	1	"	5	" 425.	"	425.00
12th	Gen.Talk.Pict. ✓	2	"	6	" 225.	"	450.00*
13th	DeForest Phono ✓	1	"	9	" 265.	"	265.00
	Gen.Talk.Pict. ✓	1	"	8	" 40.	"	40.00*
17th	" " " ✓	20	"	7	" 55.	"	1100.00*
18th	Best Mfg.Co.	1	"	5	" 425.	"	425.00
22nd	Gen.Talk.Pict. ✓	6	"	7	" 55	"	330.00*
24th	DeForest Phono. ✓	10	"	5	" 411.50	"	4115.00
	" " ✓	2	"	5	" 486.50	"	973.00
25th	Best Mfg.Co.	1	"	5	" 425	"	425.00
30th	Gen.Talk.Pict. ✓	20	"	7	" 55.	"	1100.00 *
	" " " ✓	3	"	9	billed @		
	$275 less Cr.$35.to correct				240.	"	720.00*
2nd	Gen.Talk.Pict. ✓	14	"	7	" 40.	"	560.00*
2nd	Universal Wire✓ less	1	"	1	" 36.	"	36.00
	" " ✓	2	"	2	" 57.	"	57.00
5th	Wm. Rickey	1	"	1	" 36.	"	36.00
	" "	1	"	2	" 57.	"	114.00
12th	H.W.Projector Co.✓	1	"	1	" 36.	"	36.00
	" " ✓	1	"	2	" 57.	"	57.00
17th	Triple Reflecting Arc Lamp	1	"	1	" 36.	"	36.00
	" " "	1	"	2	" 57.	"	57.00
					Total		$15438.00
CREDET							
24th	Biophone Corp.	1	"	2	" 57.		
		1	"	1	" 36.		93.00
							$15345.00
			Discount				
	*Less 2% Cash on $8120.00						162.40
							$15182.60

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Page Tightly Bound

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AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumpike

AUGUST 1929 SALES

Aug.	5th	Gen.Talk.Pict.	14	Model #7	@	$ 55.	ea.	$ 770.00*
	9th	DeForest Phonofilm	2	" 5	"	500.	"	1000.00
		" "	11	" 5	"	425.	"	4675.00
	5th	Gen.Talk.Pict.	2	" 9	billed @			
		$275.less Cr.$35.to correct				240.	"	480.00*
		Gen.Talk.Pict.	2	" 9	billed @			
		$275.less Cr.$35. to correct				240.	"	480.00*
	6th	Gen.Talk.Pict	2	" 9	billed @			
		$275.less Cr.$35. to correct				240.	"	480.00*
	7th	Gen.Talk.Pict.	3	" 9	billed @			
		$275. less Cr.$35.to correct				240.	"	720.00*
	9th	Gen.Talk.Pict.	3	" 9	billed @			
		$275. less Cr.$35. to correct				240.	"	720.00*
	10th	Gen.Talk.Pict.	8	" 7	@	55.	"	440.00*
	13th	" " "	9	" 9	billed @			
		$275.less Cr.$35.to correct				240.	"	2160.00*
	13th	Gen.Talk.Pict.	2	" 9	billed @			
		$275.less Cr. $35.to correct				240.	"	480.00*
	16th	Gen.Talk.Pict.	6	" 7	@	55.	"	330.00*
	19th	DeForest Phonofilm	2	" 9	billed @			
		$310.less Cr.$45.to correct				265.	"	530.00
	17th	DeForest Phonofilm	2	" 5	@	500.	"	1000.00
	20th	Gen.Talk.Pict.	10	" 7	"	55.	"	550.00*
	21st	" " "	4	" 7	"	55.	"	220.00*
		" " "	1	" 5	billed @			
		$425.less Cr. to correct				400.	"	400.00*
	20th	Gen.Talk.Pict.	10	" 7	@	55.	"	550.00*
	22nd	" " "	8	" 7	"	55.	"	440.00*
	23rd	" " "	8	" 9	"	240.	"	1920.00*
		" " "	6	" 7	"	55.	"	330.00*
	26th	" " "	12	" 7	"	55.	"	660.00*
		" " "	10	" 9	"	240.	"	2400.00*
	20th	Moffett	1	" 9	"	410.	"	410.00
	27th	DeForest Phonofilm	3	" 9	billed @			
		$310.less Cr.$45. to correct				265.	"	795.00
	27th	Gen.Talk.Pict.	8	" 7	@	55.	"	440.00*
	28th	" " "	10	" 7	"	55.	"	550.00*
	29th	" " "	10	" 7	"	55.	"	550.00*
	2nd	Carrier Constr.	1	" 2	"	57.	"	57.00
	13th	Theo.Chtisomalis	1	" 1	"	36.	"	36.00
		" "	1	" 2	"	57.	"	57.00
	15th	Jenkins Television	1	" 2	"	57.	"	57.00
	29th	Arcturus Tube	1	" 1	"	36.	"	36.00
	30th	Westinghouse Elec.	1	" 2	"	57.	"	57.00
							Total	$24780.00
		*2% Cash Disc. on $16070						321.40
								$24458.60

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AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Number

SEPTEMBER 1929 SALES.

Sept.	3rd	Gen.Talk.Pict.	✓	16	Model	#7	@ $	55.	ea.	$ 880.00*
		" " "	✓	4	"	7	"	55.	"	220.00*
		" " "	✓	5	"	5	"	400.	"	2000.00*
	5th	" " "	✓	12	"	7	"	55.	"	660.00*
		DeForest Phonofilm	✓	25	"	5	"	300.	"	7500.00
	6th	Gen.Talk.Pict.	✓	10	"	7	"	55.	"	550.00*
	7th	" " "	✓	6	"	7	"	55.	"	330.00*
	9th	" " "	✓	5	"	5	"	400.	"	2000.00*
	12th	" " "	✓	10	"	7	"	55.	"	550.00*
	17th	DeForest Phonofilm	✓	1	"	9	"	340.	"	340.00
	18th	Walthal --		1	"	2	"	58.50	"	58.50
	21st	DeForest Phonofilm	✓	1	"	9	"	265.	"	265.00
	23rd	Gen.Talk.Pict.	✓	5	"	9	"	240.	"	1200.00*
	24th	" " "	✓	5	"	9	"	240.	"	1200.00*
	24th	" " "	✓	6	"	7	"	55.	"	330.00*
	27th	" " "	✓	10	"	5	"	400.	"	4000.00*
	30th	" " "	✓	10	"	5	"	4000.	"	4000.00*
							Total			$26085.50
				* 2% Cash Disc. on $17920						358.40
										$25725.10

.25

1581

STATEMENT

#12

AMERICAN TRANSFORMER COMPANY

MAKERS OF

ELECTRICAL APPLIANCES

174-188 EMMET STREET

NEWARK, N. J.

1-29-30

Radio Corp. of America,
233 Broadway,
New York City.

EXAMINE THIS STATEMENT. WE RENDER ACCOUNTS ON THE FIRST OF EACH MONTH OF ALL ITEMS AS THEY APPEAR ON OUR LEDGER. IF ANY ERRORS OR OMISSIONS PLEASE ADVISE.

CHARGES			CREDITS		
DATE	MEMO.	AMOUNT	DATE	MEMO.	AMOUNT
FIRST OF MONTH BALANCE $					
	SUMMARY OF SALES				
1929	October	Sales net			21,781.65
	November	" "			10,798.50
	December	" "			16,425.85
					49,006.00
	Royalties @ 7½%				3,675.45
	Less:- overpayment three months ending September 30, 1929				91.96
					3,583.49
END OF MONTH BALANCE $					

Total Sales to be deducted $1148.40

Ledger 118

12

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Number
4464 — 4465 — 4466 — 4467

OCTOBER 1929 SALES

1929

Oct.	5	-General Talking Pictures	PA	50	8	240.00	1920.00
		-Calliphone Company	2AP	10	1	40.00	40.00
		- " "	2AP	10	1	40.00	40.00
X	7	-Butterfield Theatre	A	28	1	524.00	524.00
	10	-General Talking Pictures	PA	50	10	240.00	2400.00
		- " " "	A	41	12	55.00	660.00
	11	-Marks Brothers	A	41	1	62.50	62.50
	12	-General Talking Pictures	PA	25A	5	400.00	2000.00
	15	- " " "	A	41	10	55.00	550.00
	17	- " " "	A	41	32	55.00	1760.00
		-A. A. Eulen	A	21	1	52.65	52.65
	18	-Wholesale Radio Service	A	21	1	58.50	58.50
		-General Talking Pictures	A	41	10	55.00	550.00
	21	-Platter Cabinet	A	41	2	55.00	110.00
		- " "	PA	51	1	240.00	240.00
	19	-General Talking Pictures	A	41	6	55.00	330.00
	22	- " " "	A	41	12	55.00	660.00
	23	- " " "	A	41	12	55.00	660.00
		- " " "	PA	50	1	240.00	240.00
		- " " "	PA	50	2	240.00	480.00
		-G. Wickiser	D	21	1	65.00	65.00
	15	-M. De Vichi	2AP	10	1	40.00	40.00
	24	-Perry Smith	2AP	10	1	36.00	36.00
		- " "	D	21	1	58.50	58.50
		-M. De Vichi	D	21	1	65.00	65.00
	29	-General Talking Pictures	PA	58	3	292.50	877.50
		-Platter Cabinet	PA	51	1	240.00	240.00
	19	-General Talking Pictures	PA	50	2	240.00	480.00
		- " " "	PA	51	9	240.00	2160.00
	26	- " " "	PA	51	2	240.00	480.00
		- " " "	PA	56	1	240.00	240.00
	29	- " " "	PA	51	3	240.00	720.00
	30	- " " "	PA	51	3	240.00	720.00
	31	- " " "	PA	51	6	240.00	1440.00
		-Dooleyphone Company	A	37	1	375.00	375.00
+	5	-Penn. Storage Battery Co.	PA	25A	1	540.00	540.00
					146		21874.65

Less CREDITS

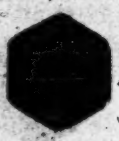
	7	-R. B. Scribner	2AP	10	1	36.00	36.00
		- " "	21A		1	57.00	57.00
							93.00
							21781.65

Inv 13576 Rent 30. less 50-10% = 43.20
Inv 13377 Oct 28- Do - 75.60
118.80

1583

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES



173-183 EMMET STREET
NEWARK, NEW JERSEY

Telephone Twinson
4454 — 4455 — 4456 — 4457

NOVEMBER 1929 SALES

Nov.	7	-S. Baraf		A	29	1	720.00	720.
		-S. "		A	33	1	270.00	270.
	5	-General Talking	✓	A	41	12	55.00	660.
	6	- " "	✓	A	41	6	55.00	330.
	1	- " "	✓	PA	51	2	240.00	480.
	2	- " "	✓	PA	51	3	240.00	720.
	4	- " "	✓	PA	51	3	240.00	720.
	9	- " "	✓	PA	51	7	240.00	1680.
	12	- " "	✓	A	41	22	55.00	1210.
	13	- " "	✓	PA	51	6	240.00	1440.
	15	-J. A. Adams		PA	51	1	270.00	270.
		-General Talking	✓	PA	51	4	240.00	960.
	27	- " "	✓	PA	51	4	240.00	960.
	21	- " "	✓	PA	51	2	240.00	480.
		-Dooleyphone Co.		A	25	1	600.00	600.
						75		11500.

Less CREDITS

1	-Wholesale Radio Sup.	D	21	1	57.00		57
3	-Blan	2AP	10	1	36.00		36
18	-Marks Brothers	A	41	1	62.50		62
26	-Powers Cinephone	A	25	1	546.00		546
				4			701
							10798

* 32 No 13576 Less 2000 less 50-10% = 388.00
* 1 " 13377 Col 18.00 " " 12.60
* 300.60
120

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumey
6000 — 6000 — 6000 — 6000

DECEMBER 1929 SALES

Dec.	4	-General Talking Pictures	A 41	16	55.00	880.00
		" " " "	PA 51	8	240.00	1920.00
	5	" " " "	A 41	9	55.00	495.00
		-International Research	D 28D	1	500.00	500.00
		" " " "	PA 63	1	159.00	159.00
	10	-General Talking Pictures	A 41	8	55.00	440.00
	11	" " " "	A 41	18	55.00	990.00
	16	" " " "	A 41	18	55.00	990.00
	18	-General Sound Equipment	C 25	2	630.00	1260.00
	12	-General Talking Pictures	PA 51	7	225.00	1575.00
	19	" " " "	A 41	10	55.00	550.00
		" " " "	PA 51	5	225.00	1125.00
	20	" " " "	A 41	10	55.00	550.00
		" " " "	PA 51	5	225.00	1125.00
	24	" " " "	A 41	14	55.00	770.00
		" " " "	PA 51	7	225.00	1575.00
	26	" " " "	A 41	10	55.00	550.00
		" " " "	PA 51	2	225.00	450.00
	28	" " " "	A 41	10	55.00	550.00
		" " " "	PA 51	1	225.00	225.00
	21	-Radio Service Company	A 24	1	65.00	65.00
		" " " "	2AP 2	1	40.00	40.00
	10	-Hammerlund Roberts	2AP 2	1	36.00	36.00
		" " "	D 21	1	58.50	58.50
	16	-Amer. Tel. & Tel. Co	2AP 2	1	40.00	40.00
		" "	D 21	1	65.00	65.00
	26	-Deits c/o Duncane Co	2AP 2	1	40.00	40.00
		" "	D 21	1	65.00	65.00
						17068.50

Less CREDITS

8	-A. A. Emlen	A 24	1	52.65	52.65
18	-Platter Cabinet	A 41	2	55.00	110.00
	" "	PA 51	2	240.00	480.00
					642.65
					16425.85

No. 13576 less 40.00 less 58-10% - 31.50
No 13377 No 28.00 No 21.20
$34.20

1585

STATEMENT

#13

AMERICAN TRANSFORMER COMPANY

MAKERS OF

ELECTRICAL APPLIANCES

174-188 EMMET STREET

NEWARK, N. J. 4/7/30

Pd 5/1/30

Radio Corp. of America,
233 Broadway,
New York City.

KINDLY CHECK THIS STATEMENT. WE RENDER ACCOUNTS ON THE FIRST OF EACH MONTH OF ALL ITEMS AS THEY APPEAR ON OUR LEDGER. IF ANY ERRORS OR OMISSIONS PLEASE ADVISE.

CHARGES			CREDITS		
DATE	MEMO.	AMOUNT	DATE	MEMO.	AMOUNT

FIRST OF MONTH BALANCE $

SUMMARY OF SALES

1930	January Sales Net		$24,733.50	188
	February	"	7,730.00	69
	March	" "	6,769.50	33
			$39,233.00	290
	Royalties @ 7½		$ 2,942.47	

END OF MONTH BALANCE $

Filed 1101.64
Subject to Withholding

119

4/10

AMERICAN TRANSFORMER COMPANY

#13

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tyrone

JANUARY 1930 SALES

Jan.	3rd	Gen.Talk.Pict.Corp.	1	PA-51 Amp.	@ $225.	$225.
	9th	Radio Shop of Newark	1	PA-56 "	240.	240.
	8th	Gen.Talk.Pict.Corp.	10	A-41 "	55.	550.
	2nd	" " " "	10	A-41 "	55.	550.
	2nd	" " " "	5	PA-51 "	225.	1125.
	7th	" " " "	10	A-41 "	55.	550.
	7th	" " " "	5	PA-51 "	225.	1125.
	10th	" " " "	10	A-41 "	55.	550.
	10th	" " " "	5	PA-51 "	225.	1125.
	13th	" " " "	16	A-41 "	55.	880.
	13th	" " " "	4	PA-51 "	225.	900.
	16th	" " " "	5	PA-51 "	225.	1125.
	16th	" " " "	10	A-41 "	55.	550.
#	16th	" " " "	12	25-A "	400.	4800.
	14th	" " " "	2	PA-51 "	225.	450.
	18th	" " " "	2	PA-51 "	225.	450.
	15th	" " " "	5	PA-51 "	225.	1125.
	15th	" " " "	10	A-41 "	55.	550.
	22nd	" " " "	20	A-41 "	55.	1100.
	22nd	" " " "	10	PA-51 "	225.	2250.
	28th	" " " "	5	PA-51 "	225.	1125.
	28th	" " " "	10	A-41 "	55.	550.
	31st	" " " "	5	PA-51 "	225.	1125.
	31st	" " " "	10	A-41 "	55	550.
	29th	Comb.Sound Eqmip.Co.	1	PA-56 "	265.	265.
	25th	Western Radio Mfg.	1	24A Pr.Box		58.50
	30th	Sentry Safety Control	1	2 AP Amp.		40.
			188			24,733.50

1 * 54. Transformers Type No 1357L Less 20. Less 50 & 10 % 486.00
14. " " " 13377 " 20 " 50 196.40
682.40

115

Used on PA 50 & PA 51 Class S
" " 25A

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumes
4444—4445—4446—4447

FEBRUARY 1930 SALES

Feb.	3rd	Gen.Talk.Pict.Corp.	5	PA-51	Amp. @	$225.	$1125.
	3rd	" " " "	10	A-41	"	55.	550.
	5th	" " " "	5	PA-51	"	225.	1125.
	5th	" " " "	10	A-41	"	55.	550.
	13th	" " " "	5	PA-51	"	225.	1125.
	13th	" " " "	10	A-41	"	55.	550.
	20th	" " " "	5	PA-51	"	225.	1125.
	20th	" " " "	10	A-41	"	55.	550.
	14th	Thos.V.Gould	1	PA-51	"	275.	275.
	28th	DeForest Phonofilm	2	PA-51	"	240.	480.
	7th	T.Southwell	1	245	"	35.	35.
	7th	" "	1	21D	Pr.Box	55.	55.
	4th	Wholesale Radio Serv.	1	21D	" "	55.	55.
	4th	" " "	1	245	Amp.	35.	35.
	10th	" " "	1	21D	Pr.Box	55.	55.
	17th	" " "	1	21D	" "	55.	55.
	17th	" " "	1	2-AP-5	Amp.	35.	35.
	1st	Universal Sound Prod.	1	21D	Pr.Box	55.	55.
							$7835.

LESS CREDIT

	1st	M & H.Sporting Goods	1	2 AP-7	Amp.	$ 40.	$ 40.
	1st	" " " " "	1	24A	Pr.Box	65.	65.
							$ 105.
							$ 7730.

* 23 Transformer No. 13576 List $ 20 ~ Less 50-10% =

.116

* Used on Pa 50 Pa 51 - Pa 51-S.

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-180 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumnes
4444—4445—4446—4447

MARCH 1930 SALES

Mar. 6th	DeForest Phonofilm	2	25A (25 cy.) Amp. @ $500.			$1000.
5th	" "	1	PA-56 Amp. 25cy.		265.	265.
3rd	Otis Elev.Co.	1	PA-60 "		215.	215.
3rd	Universal Sound Sys.	1	2 AP-2 "		35.	35.
3rd	" " "	1	21D Pr.Box		55.	55.
3rd	Audiphone Corp.	1	A-41 Amp.		62.50	62.50
18th	D.Mackintosh &Son.	1	2 AP-7 "		35.	35.
18th	"	1	21D Pr. Box		55.	55.
24th	"	1	PA-51 Amp.		240.	240.
29th	Gen.Talk.Pict.Corp.	14	PA-51 "		216.	3024.
31st	" " " "	8	PA-51 "		216.	1728.
31st	Universal Sound Sys.	1	Hi Pr. Box		55.	55.
31st	" " "	1	Amplifier		55.	55.
		34				$6804.50

LESS CREDIT

1st	Wholesale Radio Serv.	1	Type P-2 Amp.		$ 35.
		33			
					$6769.50

Net

20 | Transformers Type No. 13377 List 28.00 Less 50-10% 25.20
" " 13576 " 230.00 " 207.00
$232.20

117

1589

STATEMENT

AMERICAN TRANSFORMER COMPANY

MAKERS OF

ELECTRICAL APPLIANCES

174-188 EMMET STREET

NEWARK, N. J.

Radio Corp. of Am.,
233 Broadway,
New York City.

EXAMINE THIS STATEMENT. WE RENDER ACCOUNTS ON THE FIRST OF EACH MONTH OF ALL ITEMS AS THEY APPEAR IN OUR LEDGER. IF ANY ERRORS OR OMISSIONS PLEASE ADVISE.

CHARGES			CREDITS		
DATE	MEMO.	AMOUNT	DATE	MEMO.	AMOUNT
FIRST OF MONTH BALANCE	$				

SUMMARY OF SALES

April, 2930 Net Sales		$ 8239.25
May " " "		24970.00
June " " "		12307.50
		$49516.75
Royalties @ 7 1/2%		$3713.75

END OF MONTH BALANCE $

14

58
2414
179
481

Sales Statement
1736 80
107

1590

AMERICAN TRANSFORMER COMPANY

#14

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tampa
4444—4445—4446—4447—4448

APRIL, 1930 SALES

Apr. 9th	J. L. Moffet	1 PA-51 Amplifier	--------	$ 300.00
1st	Genl. Talk. Pict.	2 PA-51 "	--------	452.00
2d	" " "	1 PA-51 "	--------	216.00
1st	" " "	1 PA-70 "	--------	202.50
14th	Movox Corp.	2 PA-52 "	--------	125.00
28th	Genl. Talk. Pict.	30 A-41 "	--------	1500.00
28th	" " "	5 PA-51 "	--------	1125.00
30th	Arcturus Radio	1 A-41 "	--------	56.25
	" "	1 PA-51 "	--------	270.00
	Movox Corp.	2 A-52 "	--------	112.50
	Genl. Talk. Pict.	10 A-41 "	--------	500.00
	" " "	2 PA-51S "	--------	400.00
				$5239.25

RECD. MAILING DEPT. JUL 31 1930 RADIO CORP. OF AMERICA

17. Transformers Type No. 13576 108.00
110

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-180 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumpe
4444—4445—4446—4447

MAY 1930 SALES

May 1st	- Genl. Talk. Pict.	- 5	A-41 Amplifiers	------	$ 250.00
	- " " "	- 3	PA-618	" ------	600.00
	- " " "	- 3	PA-618	" ------	600.00
	- " " "	- 5	A-41	" ------	250.00
5th	- " " "	- 2	PA-618	" ------	400.00
	- " " "	-15	A-41	" ------	750.00
6th	- " " "	-10	A-41	" ------	500.00
	- " " "	- 3	PA-618	" ------	600.00
7th	- " " "	- 2	PA-618	" ------	400.00
9th	- " " "	-15	A-41	" ------	750.00
10th	- " " "	- 5	A-41	" ------	250.00
9th	- " " "	- 1	PA-618	" ------	200.00
10th	- " " "	- 7	PA-618	" ------	1400.00
12th	- " " "	- 2	PA-618	" ------	400.00
	- E. M. Zelony	- 1	25-A	" ------	540.00
15th	- Genl. Talk. Pict.	- 5	A-41	" ------	250.00
	- " " "	- 1	PA-868	" ------	200.00
	- " " "	- 5	A-41	" ------	250.00
	- " " "	- 8	A-41	" ------	400.00
17th	- " " "	- 6	A-41	" ------	300.00
	- " " "	- 4	PA-618	" ------	800.00
14th	- " " "	- 3	PA-618	" ------	600.00
15th	- " " "	- 2	PA-618	" ------	400.00
16th	- " " "	- 3	PA-618	" ------	600.00
17th	- " " "	- 2	PA-618	" ------	400.00
16th	- J. V. Moffett	- 1	25A	" ------	600.00
	- E. M. Zelony	- 1	PA-61	" ------	270.00
19th	- Genl. Talk. Pict.	- 8	A-41	" ------	400.00
	- " " "	- 1	PA-61	" ------	225.00
	- " " "	- 2	PA-618	" ------	400.00
13th	- J. J. Thomas	- 1	PA-69	" ------	195.00
20th	- Genl. Talk. Pict.	- 2	PA-618	" ------	400.00
	- " " "	- 1	PA-61	" ------	225.00
	- " " "	- 4	A-41	" ------	200.00
21st	- " " "	-12	A-41	" ------	600.00
	- " " "	- 1	PA-618	" ------	200.00
24th	- " " "	- 8	A-41	" ------	400.00
21st	- " " "	- 3	PA-61	" ------	450.00
	- " " "	- 1	PA-618	" ------	200.00
22d	- " " "	- 2	PA-61	" ------	450.00
24th	- " " "	- 2	PA-618	" ------	400.00

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-186 EMMET STREET
NEWARK, NEW JERSEY

Telephone Twelve
4[illegible]

MAY 1930 SALES CONT'D.

May 22d -	Genl. Talk. Pict.	- 1 PA-518 Amplifiers	$ 200.00
23d -	" " "	- 3 PA-518 "	600.00
24th-	" " "	- 1 PA-518 "	200.00
22d -	" " "	- 2 A-41 "	400.00
23d -	" " "	- 9 A-41 "	450.00
27th-	DeForest Phonofilm-	2 PA-50 "	480.00
26th-	Genl. Talk. Pict.	- 4 A-41 "	200.00
-	" " "	- 2 PA-518 "	400.00
27th-	" " "	-10 A-41 "	500.00
-	" " "	- 1 PA-58 "	282.50
-	" " "	- 2 A-41 "	100.00
-	" " "	- 1 PA-518 "	200.00
-	" " "	- 1 PA-518 "	200.00
28th-	" " "	- 1 26-A "	540.00
29th-	" " "	- 2 A-41 "	100.00
-	" " "	- 2 A-41 "	100.00
-	" " "	- 2 A-41 "	100.00
-	" " "	- 1 PA-58 "	282.50
-	" " "	- 4 PA-58 "	1130.00
-	" " "	- 8 A-41 "	400.00
-	" " "	- 1 PA-518 "	200.00
-	" " "	- 1 PA-518 "	200.00
			$8[illegible]970.00

144

Net

Transformers Type No. 13576 List 20 Less 50 10% $565.00

" " 13377 List 78 " 70 378.80

$ 622.80

112

1593

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-180 EIGHTH STREET
NEWARK, NEW JERSEY

Telephone Tiemey
4444—4445—4446—4447

JUNE 1930 SALES

June 2d	- Genl. Talk. Pict.	- 10 A-41 Amplifiers	------	$ 500.00
	- " " "	- 5 PA-618 "	------	1000.00
4th	- " " "	- 8 A-41 "	------	400.00
	- " " "	- 6 A-41 "	------	300.00
	- " " "	- 4 PA-618 "	------	800.00
	- " " "	- 2 PA-618 "	------	400.00
10th	- " " "	- 5 25-A "	------	1250.00
14th	- " " "	- 7 25-A "	------	2800.00
13th	- " " "	- 20 A-41 "	------	1000.00
16th	- " " "	- 10 A-41 "	------	500.00
13th	- " " "	- 7 PA-51 "	------	1575.00
16th	- " " "	- 5 PA-51 "	------	875.00
	- " " "	- 1 PA-618 "	------	200.00
17th	- " " "	- 2 PA-618 "	------	400.00
	- " " "	- 2 PA-51 "	------	450.00
	- " " "	- 10 A-41 "	------	500.00
18th	- DeForest Phonofilm	- 2 PA-50 "	------	480.00
19th	- Genl. Talk. Pict.	- 3 PA-618 "	------	600.00
	- " " "	- 6 A-41 "	------	300.00
25th	- " " "	- 10 A-41 "	------	500.00
	- " " "	- 4 A-41 "	------	200.00
26th	- " " "	- 10 A-41 "	------	500.00
	- " " "	- 6 PA-51 "	------	1290.00
27th	- " " "	- 10 A-41 "	------	500.00
30th	- " " "	- 5 PA-51 "	------	1075.00
	- " " "	- 10 A-41 "	------	500.00
	- " " "	- 12 A-41 "	------	600.00
	- Good-All Elec.	- 1 A-48 "	------	62.50
				$19307.80

* 12 Transformers Type No. 13576 List 30 Less 30-10%.
* 10 " " " 13377 " " "

STATEMENT

AMERICAN TRANSFORMER COMPANY

MAKERS OF

ELECTRICAL APPLIANCES

174-188 EMMET STREET

NEWARK, N. J.

Radio Corp. of Am.,

233 Broadway,

New York City.

EXAMINING THIS STATEMENT. WE RENDER ACCOUNTS ON THE FIRST OF EACH MONTH OF ALL ITEMS AS THEY APPEAR IN OUR LEDGER. IF ANY ERRORS OR OMISSIONS PLEASE ADVISE.

CHARGES			CREDITS		
DATE	MEMO.	AMOUNT	DATE	MEMO.	AMOUNT
FIRST OF MONTH BALANCE $					
	SUMMARY OF SALES				
	July, 1930 Net Sales				- $19107.50
	August " "				- 26408.50
	September " "				- 34734.50
					$80250 50
	Royalties @ 7 1/2%				$6018.79
END OF MONTH BALANCE $					

Total Sales this declared $211.00

104

1595

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumpa
4444—4445—4446-47-4448

#1

JULY 1930 SALES

July	8th	- Genl. Talk. Pictures	- 3-PA51 Amplifiers	-----	$ 645.0
	2d	- " " "	- 8-A41 "	-----	400.0
	10th	- " " "	- 5-PA51 "	-----	1075.0
	12th	- " " "	-10-PA51 "	-----	2150.0
	14th	- " " "	-30-A41 "	-----	1500.0
	15th	- " " "	- 3-PA51 "	-----	645.0
	15th	- " " "	-10-A41 "	-----	500.0
	16th	- " " "	- 6-A41 "	-----	300.0
	17th	- " " "	- 5-PA51 "	-----	1075.0
	18th	- " " "	- 4-A41 "	-----	200.0
	19th	- " " "	- 2-PA51 "	-----	430.0
	21st	- " " "	- 1-A62 "	-----	475.0
	21st	- " " "	- 4-PA51 "	-----	860.0
	22d	- " " "	- 1-PA51 "	-----	215.0
	23d	- " " "	-20-A41 "	-----	1000.0
	22d	- " " "	- 3-PA51 "	-----	645.0
	25th	- " " "	- 4-A41 "	-----	200.0
	24th	- " " "	- 4-PA51 "	-----	860.0
	28th	- Trans Lux Daylight Pic	1-A52 "	-----	62.5
	25th	- Genl. Talk. Pictures	-22-A41 "	-----	1100.0
	28th	- " " "	-10-A41 "	-----	500.0
	25th	- " " "	- 2-PA51 "	-----	430.0
	26th	- " " "	- 3-PA51 "	-----	645.0
	28th	- " " "	- 3-PA51 "	-----	645.0
	29th	- " " "	- 3-PA51 "	-----	645.0
		- " " "	- 8-A41 "	-----	400.0
	30th	- " " "	- 3-PA51 "	-----	645.0
	31st	- " " "	- 4-PA51 "	-----	860.0
					$19107.5

* 58 Transformers Tiffin No. 13576 - List 2 - Less 50-10% $ 52

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALTIES
ELECTRICAL APPLIANCES

172-180 EMMET STREET
NEWARK, NEW JERSEY

Telephone Bowen

AUGUST 1930 SALES

Aug.	5th	Vaughan Elec.	1-21D Power Box		$ 58.80
		Genl. Talk. Pictures	1-PA82 Amplifier		240.00
	6th	" " "	1-PA51	"	215.00
	7th	" " "	3-PA51	"	645.00
	8th	" " "	2-PA51	"	430.00
		Wilmington Elec. Spec.	1-PA51	"	300.00
		C. H. Deane	1-PA51	"	300.00
	11th	Genl. Talk. Pictures	10-A41	"	500.00
	13th	" " "	10-A41	"	500.00
		" " "	4-PA51	"	860.00
	11th	" " "	1-PA51	"	215.00
	12th	" " "	6-P51	"	1290.00
	14th	" " "	5-PA51	"	1075.00
	15th	" " "	22-A41	"	1100.00
		" " "	3-PA51	"	645.00
	16th	" " "	6-PA51	"	1290.00
	18th	" " "	5-PA51	"	1075.00
	19th	" " "	6-PA51	"	1290.00
	20th	" " "	5-PA51	"	1075.00
	21st	" " "	18-A-41	"	900.00
		" " "	3-PA51	"	645.00
	26th	" " "	9-PA51	"	1935.00
	23d	" " "	4-PA51	"	860.00
	26th	" " "	6-PA-51	"	1290.00
	26th	" " "	1-PA51	"	215.00
		" " "	8-A41	"	400.00
	27th	" " "	12-A41	"	600.00
		" " "	4-PA51	"	860.00
	28th	" " "	10-A41	"	500.00
		" " "	4-PA51	"	860.00
	29th	" " "	15-A41	"	750.00
		" " "	6-PA51	"	1290.00
	30th	" " "	8-PA51	"	1720.00
	31st	" " "	2-PA51	"	430.00
					$26408.80

96. Transformers Type No 1357L - Lesiro no Lem 50-n% - 8645

1597

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Number
[illegible]

SEPTEMBER 1930 SALES

Sept.	3d	Genl. Talk. Pictures	15 A-41	Amplifiers	$ 650.00
	9d	" " "	10 A-41	"	500.00
	8th	" " "	22 A-41	"	1100.00
	10th	" " "	15 A-41	"	750.00
	15th	Vitaphone Corp.	1-P-77	Rectifier	200.00
	13th	Genl. Sound Equip.	2-250	Amplifier	1000.00
	16th	" " "	2-250	"	1000.00
	16th	DeForest Phonofilm	2-PA51	"	480.00
	11th	Genl. Talk. Pict.	20-A41	"	1000.00
	12th	" " "	20-A41	"	1000.00
	15th	" " "	20-A41	"	1000.00
	15th	" " "	4-PA51	"	1075.00
	16th	" " "	20-A41	"	1000.00
	16th	" " "	5-PA51	"	1075.00
	18th	WEAR Bad. Corp.	1-P77	Rectifier	200.00
	18th	Sta. WMAL	1-P77	"	200.00
	19th	Bad. Sta. WMCA	1-P77	"	200.00
	17th	Wired Radio	1-P77	"	200.00
	-	Genl. Talk. Pict.	5-A41	Amplifiers	250.00
	-	" " "	5-PA51	"	1075.00
	19th	" " "	6-PA51	"	1290.00
	17th	" " "	5-A41	"	250.00
	18th	" " "	10-A41	"	500.00
	17th	Penn Bdcstg. Co.	2-P77	Rectifiers	400.00
	19th	Genl. Talk. Pict.	5 PA51	Amplifiers	1075.00
	-	" " "	10 A41	Amplifiers	500.00
	20th	" " "	10 A41	"	500.00
	-	" " "	5 PA51	"	1075.00
	22d	" " "	10 A41	"	500.00
	-	" " "	5 PA51	"	1075.00
	19th	" " "	2 PA56	"	480.00
	22d	" " "	20 A41	"	1000.00
	-	" " "	5 PA51	"	1075.00
	24th	" " "	10 A41	"	500.00
	-	" " "	5 PA51	"	1075.00
	26th	" " "	10 A41	"	500.00
	-	" " "	5 PA51	"	1075.00
	27th	Film Sound Corp.	1 PA96	"	97.75
	27th	Genl. Talk. Pictures	5 A41	"	250.00
	26th	" " "	5 PA51	"	1075.00
	-	" " "	10 A41	"	500.00

* 2 Transformers Type No. 13576 List 20. Less 50. 10% net 66.00
* 5 " " 13377 " 18. " " 63.00
10% #129.00
#774.00

AMERICAN TRANSFORMER COMPANY

TRANSFORMER SPECIALISTS
ELECTRICAL APPLIANCES

172-188 EMMET STREET
NEWARK, NEW JERSEY

Telephone Tumpe
6666—6665—6659—6660

SEPTEMBER 1950 SALES CONT'D.

Sept. 27th-	Genl. Talk. Pictures-	5-A41 Amplifiers	------	$ 250.00
-	" " " -	5-PA51 "	------	1075.00
27th-	" " " -	1-P32 "	------	90.00
-	" " " -	1-A38 "	------	127.00
29th-	" " " -	1-P32 "	------	90.00
-	" " " -	1-A36 "	------	127.00
✓-	M & H Sptg. Goods -	1-PA86 "	------	87.75
-	Genl. Talk. Pictures-	5-PA51 "	------	1075.00
30th-	" " " -	5-PA51 "	------	1075.00
29th-	" " " -	10-A41 "	------	470.00
30th-	" " " -	25-A41 "	------	1175.00
25th-	DeForest Phonofilm -	2-PA51 "	------	480.00
				$34850.50

Less Credits due

Sept. 2d -	Genl. Talk. Pict. 1-A62 billed 1/9 @ $475. should have been $350.00	----------$125.00	125.00
			$34734.50

108

(13)

1599

#16

STATEMENT

AMERICAN TRANSFORMER COMPANY

MAKERS OF

ELECTRICAL APPLIANCES

174-188 EMMET STREET

NEWARK, N. J.

. Radio Corp. of Am.,

. 233 Broadway,

. New York City.

EXAMINE THIS STATEMENT. WE RENDER ACCOUNTS ON THE FIRST OF EACH MONTH OR ALL ITEMS AS THEY APPEAR IN OUR LEDGER. IF ANY ERRORS OR OMISSIONS PLEASE ADVISE.

CHARGES			CREDITS		
DATE	MEMO.	AMOUNT	DATE	MEMO.	AMOUNT
FIRST OF MONTH BALANCE $					

SUMMARY OF SALES:

October, 1930 Net Sales - $33690.00

November " - 13046.00

December " - 12641.10

$59367.10

59367.10
+ 513.00
59880.10
- 1764.00
$58116.10

Royalty @ 7 1/2% = $4452.55

Total taken to be deducted
+1764 cc

END OF MONTH BALANCE $

95-

AMERICAN TRANSFORMER COMPANY

#16

Transformer Specialists — Electrical Manufacturers
178 EMMET ST. — NEWARK, N. J.
Telephone Tllmore 3-4000

OCTOBER SALES.

Oct.	3d -	Bakelite Co. - 1 Special Amplifier				$ 87.00
Oct.	1st-	Genl. Talking Pictures	- 5	Type	PA-51 Amp.	1025.00
			10	Type	A-41 Amp.	470.00
Oct.	3d -	" " "	-30	Type	PA-51 Amp.	3075.00
			20	"	A-41 "	940.00
	4th-	" " "	- 4	"	PA-51 "	820.00
			8	"	A-41 "	376.00
	3d -	" " "	- 2	"	25A "	750.00
	1st-	Northwest Broadcast	- 2	"	P-77 Sup.Units	400.00
	1st-	Stn. W. G. B.S.	- 1	"	P-77 Rect.—	200.00
	6th-	Genl. Talk. Pict.	- 2	"	PA-51 Amp.—	410.00
			- 4	"	A-41 " —	188.00
	7th-	" " "	- 5	"	PA-51 " —	1025.00
			10	"	A-41 " —	470.00
	10th-	Genl. Sound Corp.	- 2	"	250 " —	1000.00
	8th-	" Talking Pict.	- 5	"	PA-51 " —	1025.00
			10	"	A-41 " —	470.00
	9th-	" " "	- 6	"	PA-51 " —	1230.00
			-12	"	A-41 " —	564.00
	10th-	" " "	- 5	"	PA-51 " —	1025.00
			10	"	A-41 " —	470.00
	11th-	" " "	- 4	"	PA-51 " —	820.00
			8	"	A-41 " —	376.00
	13th-	" " "	- 4	"	PA-51 " —	820.00
			8	"	A-41 " —	376.00
	15th-	Columbia Bdcstg.	- 1	"	PA-51 " —	270.00
		" "	- 1	"	25A " —	375.00
	14th-	Genl. Talk. Pict.	- 3	"	PA-51 " —	615.00
			6	"	A-41 " —	282.00
	-	" " "	- 3	"	PA-51 " —	615.00
			6	"	A-41 " —	282.00
	16th-	" " "	- 5	"	PA-51 " —	1025.00
			15	"	A-41 " —	711.00
	17th-	" " "	- 8	"	PA-51 " —	1640.00
			18	"	A-41 " —	846.00
	28th-	" " "	- 3	"	PA-51 " —	615.00
	20th	" " "	- 5	"	PA-51 " —	1025.00
			15	"	A-41 " —	705.00
	21st-	" " "	- 4	"	PA-51 " —	820.00
			12	"	A-41 " —	564.00
	22d	" " "	8	"	A-41 " —	376.00
	23d	" " "	21	"	A-41 " —	987.00
	24th	" " "	7	"	A-41 " —	329.00

1601

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST. — NEWARK, N. J.

Telephone Tilmore 3-4444

OCT. #2

Oct. 27th	Genl. Talk. Pict.	- 3	Type PA-51	Amp	----------	615.00
28th	" " "	- 10	Type A-41	"	----------	470.00
29th	" " "	- 8	" A-41	"	----------	376.00
		4	" PA-51	"	----------	820.00
30th	" " "	- 3	" PA-51	"	----------	615.00
		2	" A-41	"	----------	94.00
25th	E. M. Zelony	- 4	" PA-86	"	----------	351.00
31st	Genl. Talk. Pict.	- 10	" PA-51	"	----------	2050.00
	Hoovenit Corp.	- 1	" PA-84	"	----------	80.00
						35045.00

LESS CREDITS:

Oct. 31	E. M. Zelony	- 1	" 25A	"	-----	135.
	" "	- 1	" PA-51	"	-----	270.
	" "	- 1	" 25A	"	-----	540.
7th	Genl. Talk. Pict.	- 5	" A-41	"		
		billed @ $50.Ea				
		should be 47.:			--- 15.	1365.00
						33680.00

7 1/2% Royalty on $33680.00 = $2526.00

* 93. Transformer Type No. 13576 Less No. Less 50 10% = 83
* 5. " " No. 13377 Less 28 " " 6
60

97

527

1

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — Electrical Manufacturers
178 EMMET ST. — NEWARK, N. J.
Telephone TErrace 3-4444

NOVEMBER SALES.

Nov.	1st	- Genl. Talk. Pict.	8	"	Type PA-81 Amp.		$ 410.00
	3d	- " " "	1	"	PA-51 "		205.00
	4th	- " " "	7	"	PA-51 "		1435.00
	5th	- " " "	4	"	PA-51 "		820.00
	6th	- " " "	7	"	PA-51 "		1435.00
	17th	- " " "	6	"	PA-51 "		1230.00
	4th	- " " "	1	"	P-56 "		240.00
			10	"	A-41 "		470.00
	5th	- " " "	10	"	A-41 "		470.00
	11th	- E. M. Zelony	1	"	PA-86 "		87.75
	11th	- E. M. Zelony	1	"	PA-86 "		87.75
	14th	- Voisophone Co.	1	"	A-53 "		78.00
	21st	- Linorophone Co.	1	"	PA-86 "		87.75
	20th	- Genl. Sound Equip.	1	"	250 "		500.00
	25th	- Genl. Talk. Pict.	10	"	PA-51 "		2050.00
			10	"	A-41 "		470.00
	28th	- " " "	5	"	PA-51 "		1025.00
	2.th	- " " "	10	"	PA-51 "		2050.00
			20	"	A-41 "		940.00
							$14091.25

LESS CREDITS:

Nov.	1st	- Trans-Lux Daylight	2	"	A-52	-- $185.00	
	5th	- Genl. Talk. Pict.	1	"	PBC Amp.	-- 50.00	
	13th	- M. & H. Sptg. Goodsl	1	"	PA-86	-- 87.75	
		- Genl. Talk. Pict.	1	"	PA-70	-- 202.50	465.25
							$13625.00
	1st	- Wired Radio	1	"	P-77 Rec.	-- 200.00	
		- Hoovenir Corp.	1	"	PA-84Amp.	-- 80.00	
		- C. E. Deane	1	"	PA-51 "	-- 300.00	580.00
							$13046.00

7 1/2% Royalty ib $13046.00 = $978.45

Transformer Type No. 13576 List $20.00 less 50-10% = $8.00
" " 13377 " 78.00 " = 12.60
$ 20.60

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AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST. — NEWARK, N. J.

Telephone Tilmore 3-4444

DECEMBER SALES.

Dec.	2d - Genl. Talk. Pict.	1	Type	PA-86 Amp.		$ 240.00
	1st- " " "	4	"	PA-51 "		820.00
		8	"	A-41 "		376.00
	2d - " " "	6	"	PA-51 "		1230.00
		12	"	A-41 "		564.00
	3d - " " "	5	"	PA-51 "		1025.00
		10	"	A-41 "		470.00
	4th- " " "	2	"	A-34 "		254.00
		2	"	P-32 "		180.00
	2d - Knickerbocker Bdcst	2	"	PA-86 "		162.00
	8th- M. & H. Sptg. Goods	1	"	PA-86 "		78.75
	3d - Geerke Co.	1	"	PA-86 "		97.50
	4th- Genl. Talk. Pict.	5	"	PA-51 "		1025.00
		10	"	A-41 "	unmounted	456.00
	8th- " " "	5	"	PA-51 "		1025.00
		10	"	A-41 "	unmounted	456.00
	18th- Lincrophone Co.	1	"	PA-86 "		97.50
	- Genl. Talk. Pict.	5	"	PA-51 "		1025.00
		10	"	A-41 "		470.00
	19th- " " "	4	"	PA-51 "		820.00
		8	"	A-41 "		376.00
	16th- Asso. Rad. Buyers	1	"	PA-84 "		72.00
	19th -W. G. Preddy	1	"	PA-86 "		87.75
	20th- Genl. Talk. Pict.	3	"	PA-51 "		615.00
		6	"	A-41 "		282.00
	27th- M. & H. Sptg. Goods	1	"	PA-85 "		82.00
	22d - W. G. Preddy	1	"	PA-86 "		87.75
	31st- AmerTran Sales Co.	1	"	A-66 "		156.00
		1	"	P-32 "		109.20
	- " "	1	"	PA-30 "		163.80
	- " "	1	"	A-36 "		156.00
	- " "	1	"	P-32 "		109.20
	- " "	1	"	PA-39 "		163.80
	- " "	1	"	A-67 "		176.80
	- " "	1	"	P-63 "		124.80
	- Knickerbocker Bdcst.	1	"	P-91 & P-92 "		325.00
						$13958.20

LESS CREDITS:

Dec.	16th W. J. Bdcstg.	1	"	PA-86 Amp.	$ 480.00	
	Penn. Bdcstg	1	"	P-77 Rec.	200.00	
	Genl. Bdcstg.	1	"	P-77 "	200.00	
	Vitaphone Co.	1	"	P-77 "	200.00	
	22- Telephone Co.	1	"	A-83 Amp.	78.00	
	- United Sound Eng.	1	"	PA-84 "	72.00	
	- Fox Elec. Mfg.	1	"	PA-86 "	87.75	1317.75
						$12641.10

1/2% Royalty on $12641.10 = $948.08

#37 Transformers Type No 13576 - Rec. No. - Amp 50-1.4% = $ 393.00

#41 Do Do 13577 - Do 38 - Do 50 40

853.40

#17

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST. — NEWARK, N. J.

Telephone TIllinghast 3-4044

ROYALTIES FOR JANUARY 1951

Jan.	5	Voicephone--- P-32 Panel	$128.00	*
	5	" --- A-36 "	180.00	*
	5	" PA-39 "	189.00	*
X	9	Larus & Bro. P-77 Rectifier	200.00	
X	12	Wired Radio P-77 Panel	200.00	
	13	C. W. Mitchell PA-86 Amplifier	87.75	
	8	Sound on Service 3-A-86 Amp. @ $78. Ea.	234.00	
	14	W. G. Preddy - PA-86 Amp.	87. 75	
	16	W. Va. Univ. PA-86 Amp.	97.50	
X	24	Kunsky-Trendle - P-77	200.00	
	22	M & H Sptg. Goods PA-85 Amp.	81.00	
X		Sta. W. G. N. P-77	200.00	
	14	Ad. Auriema PA-86	78.00	
	27	Sound on Service PA-86	87.75	
X	30	Genl. Talk. Pict. 18-PA-81 205. Ea.	3690.00	@ less 162.-
X		" " " 36 A-41 47. "	1692.00	
	23	C.C.Langevin PA-86 Amp.	87.75	
	29	M&H Sptg. Gds, PA-85 Amp.	81.00	
X	26	WIP-WPAN Bdcstg P-77 Rec.	200.00	
X	30	Cameradio P-77 Rec.	200.00	
X	23	Sta. WOBU P-77 Rec.	200.00	
	30	W. G. Preddy PA-86 Amp.	87.75	
			[illegible]	

Less Credits:

Jan. 28-	Presto Mach.	2AP-7 Amp.	$ 36.
28-	Davenport E.	PA-84 Amp.	97.50
30-	Mamas Elec.	B-PA-86 Amp.	198.00
31-	Ohio Music	A-83 Amp.	78.00
31-	LinorophoneCo	A-83 Amp.	78.00 $484.50
			[illegible]
	Less Credit below		174.60
	7 1/2% of [illegible] = [illegible]		[illegible]

Credit as above-

1 - 13577A --- $12.60

18 - 13576A --- 162.00

$174.60 These transformers were included in price of amplifiers as marked above and should not have been.

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AMERICAN TRANSFORMER COMPANY

Transformer Specialists — Electrical Manufacturers

178 EMMET ST. — NEWARK, N. J.

Telephone Tilmore 3-4444

ROYALTIES FOR FEBRUARY 1951.

Feb	1	Sound on Service	S-53	$ 78.00
	6	W. G. Preddy	PA-86 Amp.	97.75
	8	E. Markel	PA-86	117.00
		E. Markel	2 A-53 @ $105. Ea.	210.00
	10	E. Markel	2 A-72 @ $105. Ea.	210.00
	14	Genl. Talk.	2 A-86 @ $127. Ea.	254.00
		" "	2 P-52 @ 90. Ea.	180.00
	13	Sta. W. G. E. U.	P77A Panel	200.00
	16	Suffolk Elec.	P-77	200.00
	18	Linarophone Co.	PA-86	97.50
	21	Elec. Supp. Corp	PA-86	97.75
	18	Hughes-Peters	PA-86	97.75
		" "	PA-84	78.00
	24	Sta. W.B.E.N.	P-77	210.00
	19	Genl. Talk. Plot.	3 - A-86 @ $127. Ea.	381.00
		" " "	3 - P-52 @ 90. "	270.00
	25	Sta. WMAL	P-77	200.00
		Bacon Elec.	PA-86	85.25
				$3028.00

Less Credits:

20	E. Markel	A-72 Amp.	$105.
26	M A M Sptg.	PA-86	78.75
			183.75
			$2840.25
		Less Credit as below	25.20
			$2817.05

7 1/2% of $2817.05 = $211.28

Less 2-13377A Transformers $25.20 in above price of amplifier and should not be so have deducted.

FG

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST. — NEWARK, N. J.

Telephone Tilmore 3-4444

ROYALTIES FOR MARCH 1931

Mar. 1	Ad Auriema	PA-85 Amp.		$ 78.00
	Elec. Supp.	PA-86 "		87.75
2	N. J. Rad.	PA-84		99.90
6	Radio Supp.	2- PA86 Amp. @ $87.75 Ea.		175.50
11	Universal Sd. & Serv.	1PA-84		72.00
	" " "	1PA-85		83.25
10	Natl. Union Radio	PA-84		80.00
19	Universal Sd. & Serv.	PA-86		87.75
21	Universal Amp. Co.	PA-84		412.50
	"	A-80		450.00
	"	P-63		138.75
	"	PA-89		195.00
18	Knickerbocker Bdcstg.	A-87 Special		262.50
	"	2 - Type A 80B @ $220.Ea.		440.00
	"	2 - Type P-102 Panels@$15.		30.00
	"	1 - " P-77		200.00
18	W. G. Preddy	PA-86		87.75
25	Island Radio	A-87		180.00
	" "	P-63		138.75
20	W. G. Preddy	PA-86		87.75
23	W. G. Preddy	PA-86		87.75
21	Universal Amp.	PA-86		87.75
17	Hammarlund Roberts	PA-86		87.75
26	Bamberger Bdcstg.	A-80		225.00
	"	A-87		180.00
	"	P-63		138.75
31	Rad. Aid Serv.	A-80		225.00
	" " "	A-87		180.00
	" " "	P-63		138.75
	" " "	PA-84		412.50
	" " "	PA-86		87.75
	" " "	PA-84		72.00
	" " "	2 10-P-101 @ $25.20 Ea.		252.00
	Hughes-Peters	PA-86		87.75
				$5549.90

Less Credits:

31	AmerTran Sales	A-87	$276.80	
	" "	P-63	124.80	
16	M & H Sptg.	PA-85	81.00	382.60
				$5267.30

7 1/2% of $5267.30 = $395.05

7628.15 572.81

2417.05 211.28

$ 15,712.50 $ 1178.44

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Transformer Specialists

Amp Equip

AMERICAN TRANSFORMER COMPANY

178 Emmet St. Newark, N. J.

October 28, 1931

Radio Corporation of America
51st St. & Lexington Ave.
New York City

Gentlemen:

We are enclosing statements of sales made by us under our license for the second quarter of this year and also for the month of July, with these we are enclosing our check for $1366.69 for the month of July and one for $1180.93 for the second quarter of this year.

We are enclosing a check for $1178.44 covering royalties for the first part of this year and a check for $4452.53 for royalties for the fourth quarter of 1930.

The list of sales for these last two periods you already have.

A check for the royalties listed on your schedule A attached to your letter of December 18, 1930 will go forward to you very shortly.

Very truly yours,

CVL:KB

AMERICAN TRANSFORMER COMPANY

C. F. LOUGHEAD
PRESIDENT

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST., NEWARK, N. J.

Telephone Tilmore 3-4444

#18

ROYALTIES FOR APRIL, 1931

3	- Cross Mfg. Co.	PA-86	$	97.50
4	- Motion Picture Theatre	A-36		150.00
	- " " "	P-32		108.75
3	- Radio Air Serv.	A-36		150.00
	- " "	P-32		108.75
	- " "	PA-39		195.00
2	- F. A. Boykin	PA-84		48.00
	- Silmen Distrib. Co.	PA-86		97.75
4	- Universal Sd. & Serv. Co	A-67		180.00
	- " " "	P-63		138.75
2	- Warner Bros.	A-72		45.00
	- " "	PA-86		97.50
4	- Wired Radio, Inc.	P-77		200.00
10	- J. K. Elderkin	PA-84		80.00
7	- J. K. Elderkin	PA-86		97.50
6	- Bamberger Bdcstg.	A-36		150.00
	- " "	P-32		108.75
	- " "	PA-39		195.00
9	- Universal Sd. & Serv.	2-PA-84 @ 72. Ea.		144.00
	- " "	PA-86		97.75
10	- Western Radio Eng.	P-77		292.50
7	- Racon Elec. Co.	PA-83		65.25
15	- J. M. D. Greathead	PA-85		65.00
	- Royal Bdcstg. Studio	A-36		150.00
	- " "	P-32		108.75
	- " "	PA-39		195.00
17	- Elec. Supp. Corp.	PA-84		81.00
15	- " "	PA-86		97.75
	- " "	A-89 - 2-@ $80.50 Ea.		81.00
	- " "	A-89		48.50
16	- Graybar Elec.	P-77		180.00
17	- C. M. Bowman	PA-85		108.00
21	- Head of Lakes Bdcstg.	PA-86		97.50
14	- Kruse Radio	PA-86		97.50
20	- Radio Air Serv.	2 Spec. 2AP Amp. @ $46. Ea.		92.00
25	- Amusement Supp. Co.	2-A-67 @ $180. Ea.		360.00
	- " "	2-P-63 @ $138.75 Ea.		277.50
20	- Elec. Supp. Corp.	PA-86		97.75
25	- Dooleyphone Co.	PA-86		97.50
	- "	PA-88		80.00
24	- American Tel. & Tel.	PA-86		105.00
27	- H. Steirman	PA-86		97.75
	- "	101 Speaker Rect.		25.20
	- Radio Air Service	A-88		72.00
30	- Elec. Supp.	PA-86		97.75

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST., NEWARK, N. J.

Telephone TIllinois 3-4444

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ROYALTIES APRIL 1931 CONTINUED

Apr.	10 - Genl. Talking Pictures----PA-84		$ 72.00
	30 - Officer in Charge----------PA-83 --2 @ $87. Ea.---		174.00
	25 - E. M. Zelony ----------A-80 ----------		202.50
	24 - H. Stairman ----------P-79 ----------		42.75
	24 - Radio Air Service---------PA-84 ----------		550.00
	- " ---------2 - 2AP @ $46. Ea.------		92.00
	30 - Stn. W. L. T. L.---------- P-77----------		290.00
	- H. Steinmann----------PA 86----------		87.75
	- " ----------P-101 2 @ $25.20 Ea.---		50.40
			$6983.85
Less CREDITS:			
Apr.	7 - Volsophone Co.-----P-32 ----------$	126.00	
	" -----A-36 ----------	180.00	
	" -----PA-39 ----------	189.00	
	Universal Sd. Sys.--PA-86 ----------	97.50	
	14 - R. Markell---------A-72 ----------	105.00	
	- " --------- 2 A-53 @ $105.Ea.-	210.00	
	15 - Ad. Auriema---------P-83 ----------	49.98	
	- " --------PA-84----------	55.04	
	- " --------PA-85----------	61.92	
	- " --------PA-86----------	66.08	
	- Wilmington Elec.---P--51----------	300.00	
	16 - Universal Sd. Serv-PA-85----------	83.25	
	28 - Genl. Talk. Pict.--PA-39 ----------	134.90	1658.57
			$5295.28

7 1/2% Royalty on $5295.28 = $397.14 Royalty for Month

= P3

AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST., NEWARK, N. J.

Telephone Tilmore 3-4040

(14)

ROYALTIES MAY 1951

Independent Radio	-		$ 97.50
Radio Sta. WSAZ	-	2 - P-77 @292.50 Ea.	585.00
Mr. Knowles	-	PA-84S	80.00
Amusement Supp.	-	A-67	180.00
"	-	P-63	138.75
Radio Air Serv.	-	A-67B	140.40
" "	-	P-63B	108.22
Bell Tel. Lab.	-	P-106	160.00
JHD Greathead	-	PA-83	65.26
WTAR Radio Corp.	-	P-77	200.00
C. C. Langevin	-	P-108	85.00
W. G. Preddy	-	PA-86	87.50
Elec. Supp. Co.	-	2 PA-86 @ $87.75 Ea.	175.50
Royal Oaks Bdcstg		P-77	195.00
R.V. Terry	-	PA-86	97.50
Radio Air Service		PA-86	87.75
Buffalo Even. News		P-77	292.50
Ad. Auriema	-	PA-86	78 .00
Cross Mfg.	-	PA-86	97.50
C. C. Langevin	-	PA-86	87.75
E. M. Zelony	-	PA-86	87.75
Amusement Supp.	-	A-67	180.00
" "	-	P-63	138.75
Elec. Supp. Co.	-	2 PA-85 @ $81. Ea.	162.00
Electro Sound Prod		PA-84	80.00
Wireless Egert	-	PA-84	72.00
Emmanuel Miss. Coll		PA-86	117.00
" "		A-88	96.00
Ray Smith Co.	-	PA-86	97.50
Sound System Eng.		PA-83	72.50
" "	-	PA-86	97.50
Universal Sd. & Serv		2 -PA86 @ $87.75	175.50
			$4583.62

ITS:			
13 F. V. Gould-PA51		$ 275.00	
15 Bamberger Bdcstg.	- 39 PA	105.00	
" "	- 88P	108.75	
" "	- 36A	180.00	
25 Good-all Elec.	- 2 - A-65 @ $78. Ea.	156.00	
29 Elec. Supp. Co.	- PA-86	87.75	
Wired Radio	- P-77	200.00	
Warner Bros	- PA-86	97.50	1870.00
			$3283.62

7 1/2% of $3283.62 = $246.27

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AMERICAN TRANSFORMER COMPANY

Transformer Specialists — *Electrical Manufacturers*

178 EMMET ST., NEWARK, N. J.

Telephone Tilmore 3-4444

ROYALTIES JUNE 1931

June	5	Electro-Phone Corp	PA-86	$ 87.75
	3	Sun Radio Co.	PA-83	65.25
		Elec. Supply Corp.	A-89	40.50
		" " "	A-89	40.50
		" " "	PA-85	81.00
		L. Deane	PA-86	87.75
	4	Electro Sound Products	PA-84	80.00
		Universal Sd. & Serv.	A-87	180.00
		" " "	P-83	138.75
	1	" " "	A-86	150.00
		" " "	P-32	108.75
		" " "	PA-39	195.00
	5	Universal Amplifying Co.	PA-86	87.75
	9	Sta. WJBK	P-77	292.80
		L. E. Wyant	PA-86	97.50
	10	K. J. Banfer	A-86	130.00
		"	P-32	94.25
		"	PA-39	169.00
		Ad Auriema	PA-86	78.0
	9	E. H. Steinman	PA-86	87.75
	10	Electro Sound Products	8-PA-84 @ $80. Ea.	160.00
		E. Markell	2-A89 @ $54. Ea.	108.00
	8	E. H. Steinman	P-101	42.00
	5	Hughes-Peters Elec.	P-101	25.20
	13	Simplimus	A-89	45.00
		"	PA-86	90.00
	11	Elec. Serv. Supp.	PA-84	80.00
	16	Simplimus, Inc.	PA-85	90.00
	17	George Rogers	PA-86	87.75
	15	Universal Sound & Service Co.	A-86	150.00
		" " "	PA-39	195.00
		" " "	P-32	108.75
	16	E. H. Steinman	PA-84	72.00
		"	P-101	25.20
	20	Simplimus	A-89	67.50
		"	PA-85	90.00
	16	C. C. Langevin	PA-85	81.00
	17	Elec. Serv. Supp.	A-86	80.00
	23	L. E. Wyant	A-86	80.00
		Ad Auriema	A-86	64.00
	20	E. Markell	A-89	45.00
		"	PA-86	97.50
	19	K. J. Banfer	8-P-101 @ $25.20 Ea.	75.60
	22	S. L. Baraf	2 PA-86 @ $87.75 Ea.	175.50
	24	Electro-Fone Corp	PA-84	72.00

AMERICAN TRANSFORMER COMPANY

Transformer Specialists *Electrical Manufacturers*

178 EMMET ST., NEWARK, N. J.

Telephone Tilmore 3-4444

June Continued

June 23	- Benier Mfg. Co.	PA-86	$	87.75
25	- Genl. Film Co.	PA-86		97.50
	- Universal Amplifying	PA-86		87.75
27	- Thos. A. Edison	PA-84		80.00
30	- Genl. Talking Pictures	PA-84 10-8-$196. Ea.		1960.00
26	- Electro Sound Products	PA-84		72.00
23	- Elec. & Radio Distrib Co.	A-36		150.00
	" "	P-32		108.75
	" "	PA-39		195.00
	" "	A-80		225.00
	" "	P-102		117.00
				$7781.75

CREDITS:

June 12	- Radio Air Service	PA-84	$550.00	
18	- E. Markein To correct invoice		18.00	
24	- H. N. Steinman To correct invoice		16.80	584.80
				$7196.95

7 1/2% Royalty on $7196.95 = $539.52

-77.00

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#19

Transformer Specialists

AMERICAN TRANSFORMER COMPANY

178 Emmet St. Newark, N. J.

ROYALTIES FOR JULY 1931.

July 7	- Station KSOJ-Sioux C. Journal--P-77-Rec'v.		$ 200.00
	- Genl. Talking Pictures Corp.-11-PA-81-Amp.		2156.00
10	- Ad. Auriema - 1 PA-83 Amplifier		88.00
9	- Pacific Gas & Elec. Co. 1 PA-86 Ampli.		87.75
11	- Universal Sound & Serv. Co. 1 A-87 Ampli.		180.00
	" " " 1 P-65 Pr.Sup-		138.75
9	- Eugene GWile 1 PA-85 Amp.		81.00
14	- Brown & Maine 1 PA-86 Amp.		97.50
15	- Electro Sound Prod. 2 PA-84 Amp.@72. Ea.		144.00
14	- Genl. Talk. Pict. 42 A-41B Amp. @ $47. Ea.		1974.00
3	- Braclair Amusements Co. 1 PA-86 Amp.		97.50
13	- Universal Sound & Service Co. 1 PA-86 Amp.		87.75
16	- Radio & Elec. Distributors 1 PA-86 Amp.		87.75
22	- Radio Elec. Distributers 1 A-88		80.00
20	- Wenger-Brill Co. 1 PA-86 Amp.		87.75
24	- Renier Mfg. Co. 1 PA-86 Amp.		87.75
28	- K. J. Banfer- 1 PA-39		195.00
	- " - 8 P 102 @ $117. Ea.		936.00
	- " - 6 P 65B @ $142.50 Ea.		855.00
	- " - 6 A 80B @ $292.50 Ea.		1755.00
	- " - 2 P 109 @ $195. Ea.		390.00
	- " - 4 P 77 @ $292.50 Ea.		1170.00
	- " - 7 A 65E @ $90. Ea.		630.00
24	- D'Elia Elec. Co. 1 PA-85 Amp.		81.00
	- " " 1 A-88 Amp.		72.00
27	- [illegible] & H. Sporting Goods 1 PA-84 Amp.		77.00
31	- Genl. Talk. Pict. 24 PA-51B @ $196. Ea.		4704.00
	- " " 42 A-41B @ $47. Ea.		1974.00
28	- W. G. Preddy 1 PA-86 Amp.		87.75
31	- O. Alvord 1 PA-83 Amp.		87.00
31	- K. J. Banfer 3 P-109 Panels @ $169. Ea.		507.00
			$19156.25

LESS CREDITS:

July 22	- Western Rad. Eng. P-77 billed 4/10 @ $292.50 should be $200.	$ 92.50
29	- Radio & Elec. Dis. 1-A-88 Amp.	80.00
31	- K.J.Banfer 6 A-80B Amp. billed @ $1755. should be $1521.	234.00
	- @ P-65B billed $855. should be $741.	114.00
	- 8 P-102 Panels billed @ 936. should be 811.20-	124.80
	- 7 A-65 Amp. billed $630. should be $546.	84.00
	- 1 PA-39 billed @ $195. should be $169.	26.00
	- 4 P-77 billed @ $1170 should be $1014.	156.00

80

former
alists

TErrace 3-4444

Amplifier
Equipment

AMERICAN TRANSFORMER COMPANY

178 Emmet St. Newark, N. J.

ROYALTIES FOR JULY CONT'D

July 31	K.J. Banfer 2-109 Panels billed $390. should be 338. ----------	52.00	
-	1-P-109A. Supp. billed $195. should be 169. ----------	26.00	
31 -	Elec-tro-fone Corp. 1-PA86 Amp. ----------	87.75	1077.05
			$18089.20

7 1/2% of $18089.20 = $1356.69

1614

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PAGE

DEFENDANT'S EXHIBIT M

AMERICAN TRANSFORMER COMPANY
MAKERS OF ELECTRICAL APPLIANCES
172-188 EMMET ST., NEWARK, N. J.
TELEPHONE MARKET 4000
4001

May 29th, 1929

A. Schlesinger & Sons,
218 West 42nd Street,
New York City.

Attention Mr. M.A. Schlesinger

Dear Sirs:-

Mr. Zoloay informs me that you would like the patent numbers applying on the large amplifiers we have recently sold you; also you would like to know whether we are paying royalties on these amplifiers.

We pay a 7½% royalty to the Radio Corporation of America on all the amplifiers we manufacture whether they are for you or any one else. Our license agreement with the Radio Corporation is naturally very explicit in this matter. The royalties are paid in a lump sum at certain intervals throughout the year.

The license numbers which apply to our standard Type 25A amplifier, such as we have manufactured for you, are as follows:-

Type A Panel	Type P Panel	Type PA Panel
1128292	1195632	1128292
1129942	1201272	1195632
1195632	1231764	1201272
1231764	1251377	1231764
1273627	1273627	1251377
1313094	1622170	1273627
1349252		1426754
1403952		1466332
1459412		
1466332		
1520994		
1530861		

These numbers appear on license notices attached to the rear of panels.

The patent numbers which appear on the license notice attached to the Type A-41 low level amplifier are as follows:- 1231764, 1273627, 1297180, 1376789, 1401121, 1426754, 1466332, 1520994 and 1403478.

Yours very truly,
AMERICAN TRANSFORMER COMPANY
J.L. Scherzerhorn
General Manager

JLS/MCS

1616

DEFENDANT'S EXHIBIT N

a plate circuit voltage should be used such that when the grid is set at the same potential as its average potential under operating conditions the plate current is the same as its average operating value. The plate-circuit voltage is frequently called the "*B*" battery voltage.

It has become customary in speaking of grid potential to refer the grid to the *negative end of the filament;* unless otherwise stated all the curves shown in this text are so given. In case the characteristics are desired when the grid is connected to the positive end of the filament it is only

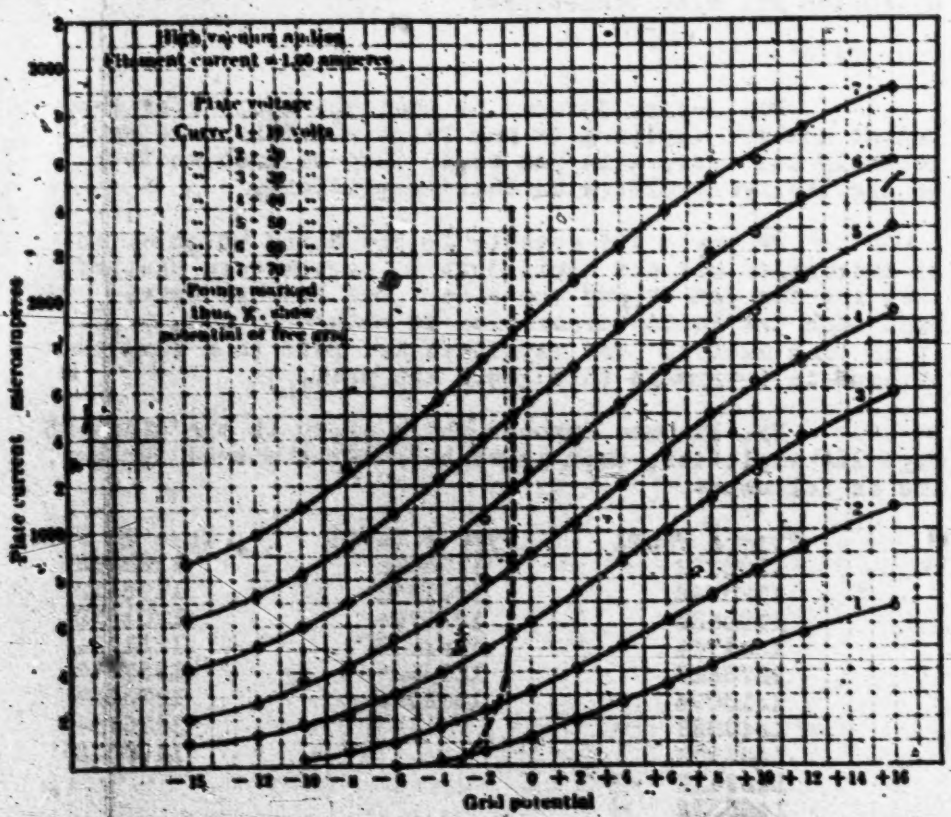


FIG. 27.—An old Deforest audion, after being well evacuated and baked, showed just as regular characteristics as the modern tube.

necessary to move the "zero grid potential" along, on the curve sheets as given, by an amount equal to the IR drop in the filament.

In Fig. 27 is shown a set of plate-current curves from an old Deforest audion, after it had been re-evacuated to take off all possible gas. The plate circuit had no added resistance except that of the *B* battery, which was so low that the variation in plate current did not appreciably affect the plate potential. On the curve sheet is shown the locus of the "free grid potential," i.e., the potential at which the grid set itself when its

4849

References Cited by the Patent Office During Prosecution of Lowenstein Patent in Suit No. 1,231,764.

De Forest	841,387
" "	995,126
Weintraub	921,930
Von Lieben	1,038,910
Stone	884,110

4850

References Cited by the Patent Office During Prosecution of Mathes Patent in Suit No. 1,426,754.

Colpitts	1,137,384
Von Lieben Reissue	13,779
Heising	1,199,180
German Patent	268,460
Pierce	1,127,371
Langmuir	1,223,496
"	1,273,627
Arnold	1,129,942

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Opinion, Byers, D. J.

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

Plaintiffs,

4853

against

GENERAL TALKING PICTURES CORPORATION,

Defendant.

In Equity Nos. 50-175, 50-177, 50-178.

September 16, 1936.

CHARLES NEAVE and HENRY R. ASHTON, Esqs., Solicitors for Plaintiffs (F. T. Woodward, H. A. Pattison and E. J. Driscoll, Esqs., of Counsel).

4854

DARBY AND DARBY, Esqs., and ZEIGER AND BERLINER, Esqs., Solicitors for Defendant (Samuel E. Darby, Jr., Ephraim Berliner and Joseph J. Zeiger, Esq., of Counsel).

BYERS, D. J.

These patent causes were tried together during February, 1934. Intervening engagements of court and counsel delayed argument until November 27, 1935.

The pleadings disclose that the plaintiff American Telephone and Telegraph Company is the owner of the several patents involved, and that the plaintiffs Western Electric Company, Inc., and Electrical Research Products, Inc., are the holders of licenses from the first-named; that the Western Electric Company, Inc., possesses all rights under or arising from said patents to exclude others from the manufacture, use, etc., of the patented devices; that the Western Electric Company, Inc., and Electrical Research 4856
Products, Inc., are possessed of all claims arising out of alleged infringement as set forth in the bill, and the rights for their own benefit to bring suit against any infringer.

The patents are eight in number, and it is unnecessary to allocate them to the three causes enumerated, because the issues are commonly identical.

The defendant was organized in September, 1928, under the laws of Delaware, and its business is that of leasing, recording and reproducing equipment for talking motion pictures in the 4857
United States; it is said to have taken over the De Forest Phonofilm Corporation which then had installed, in various theaters in the United States, talking motion picture equipment according to the sound on film system.

The plaintiffs allege that the defendant, without a license under any of the said patents, has illegally made, sold and used within the United States the inventions and improvements contained in the said patents; to restrain this alleged infringement the plaintiffs seek an injunction and the delivery to them of the alleged infringing devices and an accounting with costs.

In addition to denials, the defendant pleads that it does not manufacture, use or sell the apparatus charged to infringe, and that said apparatus was manufactured and sold to it as manufactured under the patents in suit, by a licensed manufacturer under the patents, or by those having rights to grant such licenses; and that this was done by a licensee of the owner of the patents with the latter's knowledge, consent and/or acquiescence. Also the validity of the
4859 patents is put in issue.

The major controversy concerns the legal effect of the sale to the defendant of the amplifying devices manufactured under the patents by American Transformer Company, holding a license so to manufacture and sell to certain classes of purchasers only as set forth in the license; each of the amplifying devices so purchased by defendant bears a notice reading: "This apparatus is licensed only for radio, amateur, experimental and broadcast reception under the following patents of the Radio Corpora-
4860 tion of America and Associated Companies." (The Radio Corporation of America was the licensing medium of several corporations including the three plaintiffs in this cause, and the inclusion of its name in this recital does not alter the status of the parties as heretofore stated.)

The amplifying devices required tubes which the defendant procured in the open market by purchase from authorized distributors; each tube carton bore a license notice reading as follows:

"LICENSE NOTICE.

"In connection with devices it sells, Radio Corporation of America has rights under

patents having claims (a) on the devices themselves and (b) on combination of the devices with other devices or elements, as for example in various circuits and hook-ups.

"The sale of this device carries a license under the patent claims of (a), but only for (1) talking machine uses, (2) radio amateur uses, (3) radio experimental uses and (4) radio broadcast reception; and only where no business features are involved. 4862

"The sale does not carry a license under patent claims of (b), except only (1) for legitimate renewals and repairs in apparatus and systems already licensed for use under such patent claims on combinations, (2) for assembling by amateurs and experimenters, and not by others, with other licensed parts or devices, or with parts or devices made by themselves, but only for their own amateur and experimental radio uses where no business features are involved and not for sale to or for use by others, 4863 and (3) for use with licensed talking machines and licensed radio broadcast receiving devices; and only where no business features are involved.

"This device is licensed for no other use unless, by special written contract of sale with Radio Corporation of America, the purchaser has agreed to use it in some other special manner only, as set forth in the contract of sale. The right to employ the device in such special manner is non-transferable except by special agreement with Radio Corporation of America."

The amplifying apparatus covered by the patents was produced and sold by over thirty concerns holding licenses from the plaintiffs; all of the devices, however, contained the restrictive notice first above quoted.

The defendant's position is shortly this:

That, since the plaintiffs licensed the American Transformer Company to make and sell the amplifying devices, when sales had been made by it, those devices became the absolute property
4865 of the purchaser, free from any restriction whatever, and that the purchaser had the right to use them in any way that it saw fit; in other words, to disregard the terms of the notice, although actual knowledge is conceded on the part of the purchaser, of the restricted nature of the license and of the terms of the notice at the time of purchase.

The special argument is made to avoid infringement, that the amplifying device could not be used without tubes and, as the tubes were purchased in the open market and could serve no
4866 purpose other than as equipment for amplifiers, the purchaser was free from any restriction concerning the use thereof, and particularly it was at liberty to insert the tube or tubes in these amplifiers so acquired, and make use of the complete devices without regard to the terms of either or both notices.

It is next contended that, even though the foregoing defenses should not be sustained, the court should find from the evidence that the plaintiffs acquiesced in the acquisition by the defendant of the amplifiers, with knowledge that the defendant intended to lease them for the use of moving picture theaters, and hence the plain-

tiffs should not now be heard to complain of the alleged infringement. This branch of the case involves a closely contested question of fact based upon numerous conversations between officers and representatives of the plaintiffs, and the defendant's president in connection with the development of the defendant's business.

Infringement in the usual sense is denied; it is admitted that the devices leased by the defendant to its customers embodied the inventions in the several patents, but it is asserted that 4868
each patent is for a combination of elements, namely, the structure containing the circuits and instrumentalities included therein which form a complete whole, and the radio tube or tubes which are also complete as such. It is urged that the latter require replacement from time to time as they wear out and that they have no function apart from their place in the amplifier. Therefore, as stated the defendant urges that infringement did not arise from the separate purchases of the structures, and the tubes, and the only use of the latter for which they were designed 4869
and manufactured.

Otherwise the question of infringement is not presented; thus, if the patents are valid, and the license system is lawful, and the plaintiffs have not consented to or acquiesced in the complained of acts on the part of the defendant, the plaintiffs are entitled to a decree.

Finally it is urged that the patents in suit are invalid for several reasons:

(a) That section 4886 of the Revised Statutes constitutes a statutory bar as to five of the patents, because commercial use of the device was

shown to have been practiced more than two years before the applications were filed.

(b) That Lowenstein, No. 1,231,764, is invalid for lack of invention.

Mathes, No. 1,426,754, is invalid for anticipation.

Arnold, No. 1,329,283 (power circuit) is invalid because of anticipation and want of patentable invention.

4871 Arnold, No. 1,349,252 (straight line characteristic) is invalid because of anticipation, want of patentable invention, and double patenting.

Arnold, No. 1,403,475 (resistance capacity coupling) is invalid for abandonment and complete anticipation.

Arnold, No. 1,448,550 (definite input impedance) is invalid for anticipation and double patenting.

Arnold, No. 1,465,332 (common plate supply) is invalid for anticipation.

Arnold, No. 1,520,994 (gain control) is invalid 4872 for want of novelty or patentable subject-matter.

These issues invite consideration in the order of their importance; the question concerning the legal power of the plaintiffs to restrict the defendant's use of the amplifiers is the more appropriate for consideration first, since the Lowenstein patent has been adjudicated and upheld by the Circuit Court of Appeals for the Second Circuit in the case of *Western Electric Company* v. *Wallerstein*, 60 Fed. (2d) 723. Validity thus having been established, there is a sufficient patent structure of plaintiffs to require determination primarily of this aspect of the controversy.

In considering the right of the defendant as

asserted to disregard the limitation upon use which is contained in the notices, it is necessary to recall that the defendant derived its title to the amplifier units (apart from the tubes) from the American Transformer Company, a licensee under the patent.

It should be said that no innovation was involved in the license methods employed by the plaintiffs and which are challenged by the defendant. For convenience, there is quoted from the record the following stipulation: 4874

> "It is stipulated that it is common practice, where a patented invention is applicable to different uses, to grant written licenses to manufacturers under United States Letters Patents restricted to one or more of the several fields of use permitting the exclusive or non-exclusive use of the invention by the licensee in one field and excluding its use in another field."

The different uses which these patented inventions may serve are commercial as, for instance, wire or wireless telephony for tolls, talking motion pictures in theaters for profit, etc.; and private, namely, amateur and experimental purposes, including broadcast reception. It is clear that the development of the plaintiffs' business could lawfully proceed along lines determined by them, which might well involve the application of different license methods to different fields. 4875

Further, the practice here employed calls attention to the limited terms of the license under which the American Transformer Company manufactured and sold the power supply and

power amplifying units (under license dated February 1, 1927, expiring July 1, 1931) "for radio amateur reception, radio experimental reception, and radio broadcast reception."

The license agreement defines these fields in the following provisions:

"2. (a) That the term 'amateur reception,' for the purpose of this Agreement, means reception by one not a professional

4877 investigator who is more than a mere broadcast listener, and who evidences his interest in the art of wireless telephony by study, investigation, or experiment in the art.

"(b) That the term 'experimental reception,' for the purposes of this Agreement, means the use in a laboratory, college, school or scientific society, or in professional investigations, but not in any case reception of messages, directly or indirectly for business purposes.

4878

"(c) That the term 'broadcast reception,' for the purpose of this Agreement, is defined as follows: The reception from radio telephone broadcast stations of news, music, speeches, sermons, advertising, and entertainments, educational and similar matter, or any of them, or combinations of any of them, for the purpose of exhibition, entertainment or instruction."

Further it is provided in paragraph 5:

"5. The Licensee shall affix to all Licensed Apparatus manufactured and sold by the Li-

censee under the terms of this Agreement, a license plate reading: 'Licensed only for Radio Amateur, Experimental and Broadcast Reception' and the word 'Patented,' and giving the dates of the patents and which are, in the opinion of the Radio Corporation, used in such Licensed Apparatus. The Licensee further agrees that any and all catalogs, circulars or price lists, or general advertising, of the Licensee, shall contain a statement to the effect that the Licensed Ap- 4880
paratus so manufactured and sold by the Licensee, is 'Licensed only for Radio Amateur, Experimental and Broadcast Reception,' and that all such catalogs, circulars, or price lists, or general advertising shall be subject to the approval of the Radio Corporation with respect to any reference to the Licensors or any of them, or to any matters relating to this Agreement."

Knowledge on the part of the defendant of the limitations embodied in the license agreement 4881
of the American Transformer Company was conceded by defendant's counsel, who stated:

"The American Transformer Company was licensed under each of the patents in suit, * * * by a document which granted a license to the American Transformer Company, which license was joined in by the American Telephone and Telegraph Company, and * * * the apparatus before the court under charge of infringement was manufactured by the American Transformer Company under that license. That license

was limited by express language in the license agreement to a certain use. The apparatus was sold to us with that limited license of use, in accordance with the express terms of the contract notice right on the instrument itself. That takes care of the apparatus itself, so that it raises a square issue here, about which there is no contention as I understand it."

4883 That counsel did not overstate the extent of the knowledge possessed by his client appears from a letter in evidence written by the American Transformer Company to the defendant November 23, 1928, the first and second paragraphs of which are as follows:

"We have your letter of the 17th in regard to amplifiers to be used with phonographs and the like in theatres.

"The license which we have with the Radio Corporation of America is that the
4884 amplifier is to be used for broadcasting reception and for experimental and amateur use only and not for commercial use. That is the type of license notice which is placed upon the amplifier and is the only way which we can sell them."

The defendant having been thus apprized of the precise legal situation, it becomes necessary to determine whether the licensee could confer greater rights upon the defendant company than were possessed by itself. If it could, the basis for its capacity so to endow the purchaser must reside either within the license or exterior to it. No other possibility exists.

If it is within the license, then the terms of the latter are without legal significance and the attempted restrictions must fail for lack of legal sanction; if the power proceeds from some source exterior to the license, identification thereof ought to be possible, although none has been attempted.

This aspect of the controversy confronts the defendant and may not be ignored by the contention that legal title to the amplifiers necessarily carried the right to unrestricted use. 4886

If there is no distinction between "* * * the property right in the materials composing a patented machine, and the right to use for the purpose and in the manner pointed out by the patent * * *" (*Henry* v. *A. B. Dick Co.*, 224 U. S. 1), then the defendant is justified in disregarding the issue; but if such a distinction exists its effect does not disappear from the case because the defendant chooses not to discuss it.

The opinion is presently held that the Supreme Court has not thus far decided that legal 4887 ownership of a patented device is necessarily incompatible with a restricted right to use it; if that understanding is correct, the licensee who conveyed legal title to these amplifiers, to this defendant, did not thereby confer upon the latter the legal right to offend against the restriction upon use, since it lacked the legal capacity to bring about that result.

The defendant argues that, so long as a sale of the devices was involved, it mattered not whether the sale was made by one who lacked the power to admit the defendant to a field from which the patentee had taken pains to exclude

it; that, since the defendant's legal title to the chattels was unassailable, any effort by the plaintiffs to control the use of the patented device disappeared or evaporated when the defendant acquired ownership of the amplifiers. It is said that such is the necessary consequence of the cases upon which defendant relies, although apparently none decided that such a result came about through a sale made by a licensee whose franchise in terms disabled it from
4889 accomplishing that purpose.

The court will lay aside for the moment the question of whether the licensee sought to exercise powers which were denied to it according to the terms of the license; and whether, if it did, the plaintiffs' rights were thereby affected.

For the present, it may be said that *Mitchell* v. *Hawley*, 16 Wall. 544, is thought necessarily to involve the proposition that a patent licensee can impart through a sale to a purchaser of the patented device nothing which is forbidden by the terms of his license. See also *International Pavement Co.* v. *Richardson*, 75 Fed. 590.
4890

The decisions upon which the defendant stands are said to declare that the sale by the patentee or his licensee of the patented article "ends the patent monopoly and with it all right to restrict its (the patented article's) use."

Mitchell v. *Hawley*, *supra*, is one authority to the contrary.

Adams v. *Burks*, 84 U. S. 453, and *Hobbie* v. *Jennison*, 149 U. S. 355, involve the right of assignees of the respective patents to manufacture and sell within their specified territories, although the patented articles were used elsewhere. It did not appear that restrictions as to

the place of use were imported into the relations of the parties. In the concluding portion of the opinion in the latter case, it is said:

> "It is easy for a patentee to protect himself and his assignees, when he conveys exclusive rights under the patent for particular territory. He can take care to bind every licensee or assignee, if he gives him the right to sell articles made under the patent, by imposing conditions which will 4892
> prevent any other licensee or assignee from being interfered with. There is no condition or restriction in the present case in the title of the defendant. He was the assignee and owner of the patent for the state of Michigan."

This quotation is at variance with the defendant's thesis.

Keeler v. *Standing Folding Bed Co.*, 157 U. S. 659, is a similar case.

The defendant also relies upon the price-fixing 4893
cases reviewed in *U. S.* v. *General Electric Co.*, 272 U. S. 476. Those cases are described by the court itself in the following language:

> "These cases really are only instances of the application of the principle of *Adams* v. *Burke*, 17 Wall. 453, 456, already referred to, that a patentee may not attach to the article made by him, or with his consent, a condition running with the article in the hands of purchasers, limiting the price at which one who becomes its owner for full consideration shall part with it. They do

no consider or condemn a restriction put by a patentee upon his licensee as to the prices at which the latter shall sell articles which he makes and only can make legally under the license. The authority of *Bement* v. *Harrow Company* (186 U. S. 70), has not been shaken by the cases we have reviewed.

"For the reasons given, we sustain the validity of the license granted by the Electric Company to the Westinghouse Com-
4895 pany. The decree of the District Court dismissing the bill is affirmed."

The presently important aspect of that case deals with the license from the General Electric Company to the Westinghouse Company to make and to sell at a certain price, electric bulbs covered by the General Electric patents. The theory on which that license was held to be valid is thus expounded by the court, at page 490:

4896 "The patentee may make and grant a license to another to make and use the patented articles, but withhold his right to sell them. The licensee in such a case acquires an interest in the articles made. He owns the material of them and may use them. But if he sells them, he infringes the right of the patentee, and may be held for damages and enjoined. If the patentee goes further, and licenses the selling of the articles, may he limit the selling by limiting the method of sale and the price? We think he may do so, provided the conditions of sale are normally and reasonably adapted to

secure pecuniary reward for the patentee's monopoly. One of the valuable elements of the exclusive right of a patentee is to acquire profit by the price at which the article is sold. The higher the price, the greater the profit, unless it is prohibitory. When the patentee licenses another to make and vend, and retains the right to continue to make and vend on his own account, the price at which his licensee will sell will necessarily affect the price at which he can 4898
sell his own patented goods. It would seem entirely reasonable that he should say to the licensee, 'Yes, you may make and sell articles under my patent, but not so as to destroy the profit that I wish to obtain by making them and selling them myself.' He does not thereby sell outright to the licensee the articles the latter may make and sell, or vest absolute ownership in them. He restricts the property and interest the licensee has in the goods he makes and proposes to sell." 4899

If the patentee might limit the method of sale employed by the licensee, clearly there was retained in the former a right of control having its origin in the grant of the patent, which existed apart from and was not to be confused with the transition of legal title to the bulbs from the licensee to a purchaser from the latter.

If this were not so, there would be no substance to the statement that the patentee may protect the distribution that he retains against the inroads of the licensee's competition. Here it would seem that a parity of reasoning would

justify the plaintiffs in protecting their own rights to sell these amplifiers in the special fields of distribution not open to the licensee, against the competition alike of the licensee and of those claiming—through sale by it—the right to invade those fields. If this is sound, the acquisition of instruments of invasion, with knowledge of the limitation of use attaching thereto, puts the purchaser into the same category as the licensee itself, so far as this ques-
4901 tion is involved.

Apparently the defendant would construe the *General Electric* case to protect the patentee only against the competition of its licensee and not against that of purchasers from the latter. Perhaps that position is sound, but, if it is, demonstration is not to be found in the other cases upon which reliance is had, nor was the element of actual knowledge of the licensee's limited functions present in any of them.

The most important is that of *Motion Picture Patents Company* v. *Universal Film Manufac-*
4902 *turing Company*, 243 U. S. 502. In that case, the manufacturer had licensed another to make and sell the patented device and required that the latter should contain a notice to the effect that the machine could only be used in connection with unpatented articles, and the decision was that this could not be permitted. The questions for decision are those stated by the court:

> "First. May a patentee or his assignee license another to manufacture and sell a patented machine, and by a mere notice attached to it limit its use by the purchaser or by the purchaser's lessee, to films which

are no part of the patented machine, and which are not patented?

"Second. May the assignee of a patent, which has licensed another to make and sell the machine covered by it, by a mere notice attached to such machine, limit the use of it by the purchaser or by the purchaser's lessee to terms not stated in the notice, but which are to be fixed, after sale, by such assignee, in its discretion?"

4904

The court in its decision answers these questions in the negative and overrules the decision of *Henry* v. *A. B. Dick Company*, 224 U. S. 1. The court says quite definitely that the grant of the patent did not confer upon the owner the right by notice attached to the machine to "in effect extend the scope of its patent monopoly by restricting the use of it to materials necessary in its operation, but which are no part of the patented invention, or to send its machines forth into the channels of trade in the country subject to conditions as to use or royalty to be paid, to be imposed thereafter at the discretion of such patent owner."

4905

As the decision is here understood, the court did not decide the issue upon the ground that title had passed to the machines and therefore their use was not subject to any restriction imposed by the patentee, but for the reason quoted; namely, that the patent could not be used as an instrument of oppression to project its monopoly so as to cover unpatented things.

Carbice Corporation of America v. *American Patents Development Corporation*, 283 U. S. 27, is to the same effect, and does not touch the issue here discussed.

It should be said that the right which the plaintiffs assert, to restrict the use of the patented devices, has received tacit or direct recognition in the following cases:

> *Skee Ball Co.* v. *Cohen*, 286 Fed. 275;
> *Dickerson* v. *Tinling*, 84 Fed. 192;
> *Dickerson* v. *Matheson*, 57 Fed. 524;
> *General Electric Co.* v. *Continental Lamp Works, Inc.*, 280 Fed. 846.

4907

In the last, a preliminary injunction was ordered on appeal in this circuit where it was urged that the purchaser of bases for use with electric light bulbs acquired a tacit permission to use the bulbs themselves which were covered by Letters Patent, although the bases contained a notice reading:

> "The sale of bases by us confers on the purchaser no license under any patents of the General Electric Company covering or relating to the structure of Incandescent Lamps, or the materials, machines, or processes used in their manufacture."

4908

In the course of its opinion, the court says:

> "Use of an invention can only be obtained on the inventor's terms. Without paying or doing whatever he exacts, no one can be exempt from his right to exclude, and, whatever the terms, the courts will enforce them, provided only that the licensee is not thereby required to violate some law outside of the patent law. (Citing cases.)

"So, where the owner of a patent sells a patented article subject to a restriction, the purchasers, with notice of this limitation, could acquire no better right than strangers to infringe upon that part or claim of the monopoly still secured to the patentee. *Dickerson* v. *Tinling*, 84 Fed. 192."

See also *Independent Wireless Telegraph Company* v. *Radio Corporation of America*, 269 U. S. 459. The matter decided in this case was 4910
that the patentee was properly joined as co-plaintiff by a licensee in an infringement suit, in which the defendant was charged with having used the patented device in violation of the rights which it acquired by purchase and which were defined in a label upon the device. The court said:

"The defendant, the Independent Wireless Company, has bought the same apparatus with the lawful right to use it in the amateur and experimental field only. The apparatus thus bought bears a label with 4911
such a limitation on its use. The charge in the bill is that the Independent Company is using the apparatus, or the part of it called 'radio tubes,' in the commercial radio field between ship and shore for pay and thus is violating the Radio Corporation's rights in this field."

In that case, the Radio Corporation was the licensee. The capacity of the Radio Corporation is described as follows:

"Thus there came from the De Forest Company to the Radio Corporation, ex-

clusive rights to use and sell in the United States, for radio purposes, apparatus for transmission of messages, and especially for use between ship and shore for pay."

Clearly the opportunity was presented to the court to dismiss the litigation on the ground that the restricted use recited in the label was incompatible with the act of purchase and sale of the tubes, but the court did not so dispose
4913 of the case.

It results from the foregoing cases that the mere fact of sale by the licensee, American Transformer Company, to the defendant did not deprive the plaintiffs of their rights to exclude the defendant from the fields of operation and distribution of the patented device which the plaintiffs have reserved, according to the terms of the license granted to the American Transformer Company, to the defendant's actual knowledge.

Turning now to the question of acquiesence as
4914 alleged, on the part of the plaintiffs, in the purchases by the defendant from the American Transformer Company, it should be observed that this is a decidedly critical issue. If in fact the record demonstrates that the plaintiffs connived at or acquiesced in the defendant's purchases with knowledge of their purpose, and then later, through this litigation, sought to repudiate their former conduct, the plainest principles of equity would stand in their way.

The defendant made its first purchases of these amplifiers in the month of February, 1929, nearly five months after its incorporation. Thereafter the defendant leased a complete talking

motion picture equipment, which included one of these amplifiers, to a theater in Allentown, Pennsylvania, where the equipment was installed during the month of April. On the 19th day of that month, the plaintiffs' investigators examined the equipment in order to ascertain the precise facts with reference to the operation of the various circuits and whether the plaintiffs' patents were involved. This was a substantial task and a report, based upon the studies, was not completed until some time during the month of July, 1929, 4916
and by the end of August the executive officers authorized the institution of this suit; these several bills were filed September 13th.

The record indicates that there were other suits involving some or all of the patents now before the court, started during the months of April and June of 1929, but, in the absence of an understanding of the issues so presented, it is thought that such fact is of no present consequence. There is no plea of laches made for the defendant and consequently there is no necessity for making a finding on the subject. If there 4917
were, it would be in the negative.

The contentions of acquiescence involve four separate elements:

(a) Conversation said to have occurred between the president of the defendant and one or more of the executive officers of the Radio Corporation (the status of which has been heretofore explained) and the Western Electric Company and the Electrical Research Products, Inc.

(b) Conversations between the president of the defendant and the president of the American

Transformer Company resulting in the writing of a letter, which is in evidence, by the latter to the defendant on July 24, 1929.

(c) Conversations between the president of the American Transformer Company and one of the engineers in the employ of the Western Electric Company, and one or more conversations between a special salesman of the American Transformer Company and the then president of the
4919 Electrical Research Products, Inc.

(d) The acceptance of payments from the licensee, with knowledge that they included royalties in connection with the sales made to this defendant.

The defendant urges that, by reason of the incidents connected with some or all of the foregoing, it must be found that acquiescence has been established by the proofs.

The extent to which the defendant may be thought to rely upon these things must be
4920 weighed in connection with its having procured, prior to any of the events in question, the advice of patent counsel to the effect that the license system employed by the plaintiffs was ineffectual and legally deficient. The defendant was, of course, justified in seeking to gain advantage from the practical as well as the theoretical or legal aspect of the situation, and it cannot be said, because it did not elect to stand upon either the alleged legal infirmities of the plaintiffs' methods and practice, or the conduct relied upon to establish acquiescence, that it may not now urge both theories of defense; but the attitude of mind on the part of the defendant's

president, as reflected in the evidence, may well be consulted in determining what the testimony may be deemed to have established concerning these issues of fact.

In order to discuss (a) above, it is necessary to have in mind the date of the letter referred to in (b) because it indicates that, as of July 24, 1929, the president of the defendant still deemed it necessary to secure written assurance that the supply of amplifiers would continue to be available to his company, and that royalties payable 4922
under the license were not in default, and that the licensee had conducted interviews with an unnamed representative of the Western Electric Company (quoting) "in which it was mentioned that we have been supplying these amplifiers freely to you and others and no question has been raised as to our rights to make such sales. As a matter of fact our books are open to inspection by the Radio Corporation of America and they are fully aware of the fact that we are dealing with you and they have raised no objection whatsoever." This is Defendant's Exhibit 4923
K.

The letter embodies an option for 2,000 amplifiers to be taken within a period of one year, and is signed by the president of the licensee. (He had been such from about the middle of June, 1929.) It may be said in passing that the genesis of that letter was never satisfactorily explained. The impression in the mind of the court is that it was inspired and composed outside of the licensee's office, but no finding on that subject can be made.

The question is: Why the letter, if, five months or so prior to its date, assurances had been given

for the plaintiffs, that the purchases by the defendant were acceptable to the plaintiffs?

The testimony relied upon to establish a prior tacit agreement with the defendant's president on the part of Mr. Otterson, president of the Electrical Research Products, Inc., Mr. Knox, vice-president of the same company, and Mr. Sarnoff, president of the Radio Corporation of America, is affirmative for the defendant on the part of Mr. Schlesinger, and is negative on the
4925 part of these other witnesses. The conflict is direct and one or the other version must be relied upon by this court.

It is probable that during parts of 1928 and the early months of 1929 the defendant's president had in mind a rather diplomatic and veiled effort to accomplish the purpose of gaining approval of these purchases, either before or after they were made; he was in fairly frequent consultation with the other gentlemen who have been named, in reference to patents—mostly De Forest patents—which his company was in the
4926 process of acquiring; of course, those representing the plaintiff companies knew what business Mr. Schlesinger was conducting and what its future requirements were likely to be.

They conferred, for instance, about his interests in moving picture theaters in South Africa, and doubtless they contemplated the possible establishment of business relations in that field which would be mutually profitable.

It is possible also that Schlesinger recalls remarks that he made concerning the business activities of his company which he intended to be sufficient to put the officers named of the plaintiff companies on notice that he was purchasing

amplifiers from the licensee in question. As stated, he had taken advice on the license question as early as September of 1928, and procured the said opinion of counsel, the date of which is not disclosed because its offer in evidence resulted in its exclusion under objections.

Thus Schlesinger's mental attitude during these months was either that the license system of the plaintiffs was legally objectionable, or that he could circumvent it through adroit discourse, but the utmost that can be attributed to the officers of the plaintiffs, from the evidence, was a general understanding of the defendant's business, methods, and purposes. Having seen and observed the witnesses and having weighed their testimony carefully, the court is unable to conclude that there was anything approaching a meeting of the minds between the defendant's president on the one hand and the three other gentlemen named on the other, on the proposition that the purchase of these amplifiers by the defendant company from the American Transformer Company was consented to, approved of, or deemed to be unimportant, from the plaintiffs' standpoint. 4928 4929

This conclusion is fortified by the reflection that, if the defendant's president had been sure of his ground as the result of these various interviews with the officers of the plaintiffs, he would not have felt it necessary to exact the letter from the Transformer Company on the 24th of July, 1929, which has heretofore been referred to.

It is unnecessary to dwell at length upon the legal effect to be accorded to the interviews between Loughead, the president of the licensee,

and the president of the defendant. Nobody seriously urges that the licensee could expand its own powers and, by any representations, change or enlarge its legal capacity as a licensee of the plaintiff companies. It must be recalled that the defendant knew as early as November of 1928 of the terms of the restrictions under which the licensee sold these amplifiers, and no reputed consent on the part of Young, an engineer in the employ of the Western Electric Company, as-
4931 serted to have been evolved as the result of conversations between Loughead and him, could change the legal relations between the patentee and the licensee.

In this connection it is urged that Zelony, a special selling representative of the licensee, had fortified himself while making these sales to the defendant by interviewing Mr. Otterson at that time, and by mentioning the defendant company to him and the fact that sales were being made to it, which elicited no observation from Mr. Otterson save the statement that, so far as he was
4932 concerned, there was no objection.

Zelony so testified, and Otterson denied that the interview ever took place. The court relies upon the testimony of the latter as being inherently the more probable.

On this general subject, the plaintiffs point out that both Otterson, and, of course, the vice-president under him, and Sarnoff lacked power to give any legal consent to the change in the form of the license agreement held by the American Transformer Company or to confer upon the defendant the right to acquire the amplifiers in violation of the terms of the notice which each instrument bore.

This is sound as a legal proposition, but, in view of the complex intercorporate relations maintained by the plaintiffs and their associates, concerning which familiarity could not be ascribed to outsiders, the decision on this branch of the case will not be based upon that ground. It is simply found, as a matter of fact, that the defendant has not sustained its burden of proof to establish acquiescence on the part of the plaintiffs in its purchase of the amplifiers from the American Transformer Company for use in vio- 4934
lation of the terms of the notice attached to each amplifier, and that on the contrary, when it made these purchases, it knew that the American Transformer Company did not have the legel capacity to make sales in violation of its own license agreement or in derogation of said notice.

Reference should be made briefly to the subject of royalties paid by the licensee to the Radio Corporation, covering the sales of these amplifiers to the defendant.

The evidence shows that during the month of December, 1929, three months after these suits 4935
were filed, the American Transformer Company, pursuant to request, began to furnish to the Radio Corporation lists of its customers (including this defendant) to whom amplifiers had been sold, and that, one year later, the royalty payments which applied to the defendant's purchases were returned to and accepted by the licensee.

The defendant urges that some legal conclusion favorable to it should be drawn from the fact of the making of reports in December of 1929.

It is difficult to follow the reasoning. If the

sales so reported occurred after the suits were filed, and knowledge of them could be imputed to these plaintiffs, perhaps an appropriate issue could have been presented in a supplemental pleading, but none was so made.

It is true that the books of the licensee were open to the plaintiffs' inspection, which means that, if efforts had been made to police the licensee, the sales made in February of 1929, would have come to light promptly, instead of
4937 two months later when the installation in Allentown first came to the plaintiffs' notice. That probably means only that these suits would have been filed that much sooner.

There is nothing in the evidence which tends to show that the plaintiffs, or their licensing agent, the Radio Corporation, prior to the filing of these suits, received royalties from the American Transformer Company, with knowledge that they were paid on account of sales of amplifiers to the defendant, which had been made contrary to the terms of the license, and for use of the
4938 devices in violation of the notice attached to them.

Had such a showing been made, a serious issue of estoppel or acquiescence would have been present, but, in the absence of evidence to that effect, it is unnecessary to discuss its probable effect upon the plaintiffs' cause.

The next argument of the defendant is that the charge of infringement does not lie, because its purchase of the tubes, as one of the two elements in the combination required to be established for the completion of the patented device, necessarily permitted it to make the only possible use of the tubes of which they were capa-

ble. In other words, that the tubes were designed, for instance, to be employed only as elements in the circuit of the power circuit patent of Arnold No. 1,329,283, and their use, as such, cannot constitute an infringement of that patent.

This loses sight of the fact that the tubes could be so attached, and the circuit could function in the hands of the defendant, as permitted by the terms of the notice attached to the amplifiers, namely, for experimental or radio amateur use. 4940

It is for use in *excluded* fields, that plaintiffs sue.

The defendant relies upon *Edison Electric Light Co.* v. *Peninsular Light, Power & Heat Co.*, 101 Fed. 31, and *Thomson-Houston Electric Co.* v. *Illinois Telephone Const. Co.*, 143 Fed. 534.

In the former, the electric equipment involved was held to be subject to an implied license to use in connection with the plaintiff's inventions and there was no notice of any contrary restriction. The court says: "It is evident that the extent of an implied license must depend upon the 4941 peculiar facts of each case." The facts there present were indeed remote from those now under examination; as were also the facts in the second case.

The case of *General Electric Co.* v. *Continental Lamp Works, Inc., supra*, passes upon a similar contention concerning the lamp bases there involved, as follows:

> "The sale of an element of a patented combination does not necessarily imply license to use the whole combination. There is always a question of what is a fair inference from the transaction."

After quoting from Judge Lurton's opinion in the *Edison Electric Light Co.* case, *supra*, the court continues:

"We accept this statement of the law, and with it as a guide we think the parties here did not intend that an implied license be granted. The mere sale imports no license, except where the circumstances plainly indicate that it did, or except where good faith
4943 required it, or where it cannot be doubted that the vendee understood that they were getting a license. We are convinced that, in view of what was written in the terms of sale, there was no justification for the vendee's being thus persuaded. *Natl. Cash Register* v. *Grobet*, 153 Fed. 905, 82 C. C. A. 651; *Thomson Co.* v. *Ill. Tel. Const. Co.*, 152 Fed. 631, 81 C. C. A. 473; *Montross* v. *Mabie* (C. C.), 30 Fed. 234. We find nothing in the conduct or language which would justify the appellees to be led to any course of conduct
4944 justifying their use of the patented lamp in connection with these bases. The bases were capable of non-infringing uses, and the notice on its face was intended to warn against the use by infringement of the patent in suit."

See also:

Popsicle Corporation v. *Weiss*, 40 Fed. (2d) 301 at 302;

Nachman Spring-Filled Corporation v. *Kay Mfg. Corporation*, 78 Fed. (2d) 653 at 657.

It is concluded that this defendant cannot avoid the issue of infringement on the theory stated, because it has not brought itself within the first case upon which it relies. This defendant is clearly shown to have had actual knowledge of the restricted use of the tubes when combined with the rest of the amplifier; and the combination of the two elements constituting the amplifier was capable of use by a purchaser from the licensee in fields to which the restrictions did not apply. 4946

The final ground of defense presents the question of validity of the various patents upon which plaintiffs rely. All of them have to do either with the three electrode vacuum tube or the circuit organization of which that tube forms a part.

It will be convenient to consider the patents in the following order:

Lowenstein, No. 1,231,764 (Claims 1, 2, 4, 5, 6, 7):

These claims were held valid and infringed 4947
in *Western Electric Co.* v. *Wallerstein*, 60 Fed. (2d) 723. In that case the importance of the negative grid bias in the three electrode tube is explained; that is to say, that the grid must not be permitted to become more positive than the filament so that the traffic or flow of the electrons given off by the filament to the plate may not be diverted even in part to the grid; in other words that there may be no current in the input or grid circuit, for, if that were permitted, a loss of energy would result and that in turn would contribute distortion to the process of relaying and amplifying the incoming signals.

See also *Radio Corporation of America* v. *Majestic Distributors*, 6 Fed. Supp. 87, at page 89, for a brief outline of the art involved as it developed subsequent to the time of the Fleming valve.

The defendant's brief asserts that the prior art upon which the defendant relies to defeat Lowenstein is the same as that which was before the court in the *Wallerstein* case, which obviously relieves this court of the duty of re-
4949 examining the subject. Even if there is a present disposition to be more critical than formerly in recognizing the presence of invention (*Technidyne Corporation* v. *McPhilben-Keator, Inc.*, 72 Fed. [2d] 242) in kindred fields, revision of the adjudication of this patent does not pertain to the court of instance.

Accordingly the Lowenstein patent in suit is held to be valid and to have been infringed.

Mathes, No. 1,426,754:

This patent has to do with the tube and re-
4950 lates to sources of direct current potential for the input circuit. Claim 8 alone is involved, namely:

> "8. In an electric translating circuit, an electron discharge device having a cathode, an anode and an auxiliary electrode, said auxiliary electrode and said cathode being in the input circuit of said tube, a source of current connected to said cathode, a resistance, a circuit containing said cathode, said source and said resistance in series, said resistance being also included in the input circuit of said tube in such a manner

> that the potential of said auxiliary electrode is normally maintained lower than any part of said cathode by an amount substantially equal to the drop in said resistance, said cathode being rendered thermionically active by current flowing in said series circuit."

Mathes imposes the negative bias on the grid by interposing a resistance between the negative terminal of the battery C (which causes the filament to discharge electrons) and the grid; 4952
this resistance causes the grid to be negative in potential with relation to the anode by the drop in potential across the resistance.

In other words, the C battery of Lowenstein is replaced by the resistance employed by Mathes.

This claim was not before the court in the *Wallerstein* case but claim 25 was, which is not here involved. That claim related to means for compensating for fluctuations in the potential of the output circuit. In the course of that opinion, the court said, at page 732: 4953

> "The use of the resistance as a means for effecting grid bias was invented shortly before Mathes' application."

That expression occurs in the discussion of claim 25 and apparently was not necessary to its adjudication. Whether it is binding upon this court depends upon whether it involves judicial appraisal of the prior art here relied upon.

It is thought that the reference to "Colpitts and Arnold," referred to at the close of the paragraph from which the quotation is taken,

means Arnold, No. 1,504,527, and *Colpitts, No. 1,128,292,* and neither patent is relied on by the defendant in this case to establish art prior to Mathes.

The defendant does rely principally on *Arnold, No. 1,129,942* and *Arnold, No. 1,129,943.* The disclosures therein are substantially alike, and the argument of counsel had largely to do with the first-mentioned. Apparently that patent was cited by the Examiner who passed upon Mathes'
4955 application, which was allowed over it for the reason that Mathes urged that the Arnold patent "uses a separate battery in the case of each tube for supplying the grid with the proper potential."

The former patent is typical of the art upon which defendant relies, and alone will be discussed. In figure 5, the audion tubes, according to the testimony, are connected in series and the filament electrodes are heated from a common source, battery 12. The grid electrodes of the second and third tubes are provided with
4956 means for maintaining them negative with respect to the filament, namely, C battery 11, resistance 14, and the resistance of the filament of the first tube. It is that resistance upon which the defendant relies to demonstrate that it was known to the art that any resistance in the input circuit would impress a negative bias upon the grid in that circuit. The question for decision, therefore, is whether it was known on October 23, 1916, when the Mathes application was filed, that the presence of resistance in the input circuit would accomplish the negative bias required for the efficient operation of the three

electrode vacuum tube as an element in an amplifier.

This Arnold application was filed May 28, 1914, and the invention was said to relate to the use of repeaters generally and of vacuum discharge repeaters more particularly as amplifiers, without transformers. The specifications seem to refer to the desirability of excluding transformers from the circuit, particularly where amplification is desired in circuits of a low impedance. It is said that audions of the usual 4958
type "may be so constructed that, without the use of transformers, they will step up the input voltage of either direct current or alternating current of any frequency in one step as much as 30 times its original value, or in 2 successive steps to as much as 500 times its original value." A step down of the input voltage is also possible where a high current and low voltage output is desirable. It is said in connection with figure 4: "The batteries 11 are preferably of such value as to make each of the grids 3, 5 and 7 4959
normally about five volts negative with respect to its adjacent filament."

The claims of the patent should be read in connection with the specifications and, when this is done, it will be perceived that the invention claimed was not that asserted by Mathes, and it would seem that the value of the arrangement whereby the grids were maintained negative with respect to the filament was not recognized or discussed as a desirable end in itself.

It is testified for the plaintiffs that Mathes has the advantage "that if the battery system of the tube fluctuates, as for example by charg-

ing as illustrated in fig. 1 of the drawings, the bias is made to vary as the grid current varies."

It is not denied that battery 11 in figure 5 of Arnold No. 1,129,942 must function in order that the grids of the second and third tubes may be negative; that is the necessity which gives rise to the presence of that battery. It must be concluded, therefore, that the negative bias is obtained from that battery and not as the result of the resistance heretofore referred to.

4961 The defendant's brief seeks to avoid the testimony of Mr. Waterman, the plaintiffs' expert on this subject, by arguing that, if the circuit connection of Arnold produces a negative potential on the grid electrode, it is not important "whether or not additional instrumentality such as batteries, etc., may be employed to magnify or raise to a greater degree the negative potential applied thereto." The court must rely upon testimony rather than argument and, as the presence of the negative potential is accounted for by the presence of the battery 11 rather than

4962 by the resistance of the first tube, it is thought that Arnold did not teach that which is claimed as the Mathes invention, and since there is no testimony to the effect that what Mathes accomplished was the adaptation of a mere expedient which any electrical engineer would sooner or later be expected to devise in order to eliminate the C battery of Lowenstein, it must be concluded that the Mathes patent does not lack validity for the reason assigned by the defendant.

It should be said that the late Judge Winslow decided that this claim of the Mathes patent was valid in the case of *Radio Corporation of Amer-*

ica v. *J. H. Bunnell & Co.*, 22 Fed. (2d) 847. This conclusion sustaining validity agrees with that of the Examiner in the Patent Office.

Arnold, No. 1,329,283:

This and the five other patents granted to the same inventor which are here involved invite general comment.

De Forest was responsible for adding the grid to the *Fleming* two element tube, and it has been judicially declared (*Western Electric Co.* v. *Wallerstein, supra*) that De Forest "had made little progress with it as an amplifier prior to 1912." It was about then that he took the device to the Telephone Company. In his patent No. 879,532 (application filed January 29, 1907) covering a three element tube, he said: 4964

> "I have determined experimentally that the presence of the conducting member a, which as before stated may be grid-shaped, increases the sensitiveness of the oscillation detector and, inasmuch as the explanation of this phenomenon is exceedingly complex and at best would be merely tentative, I do not deem it necessary herein to enter into a detailed statement of what I believe to be the probable explanation." 4965

In the *Stone and Cabot patent, No. 884,110*, application filed January 4, 1907, having to do with the audion ("a device which is now well known and which has been fully described in a paper by Dr. Lee De Forest published in the Proceedings of the American Institute of Electrical Engineers, October, 1906, p. 719") it is stated:

"We have found that the sensitiveness of the audion, when connected as above described with a closed oscillating circuit, is greatly impaired from causes which are somewhat obscure and which we deem it unnecessary to discuss herein."

Such was the device that in 1912 invited the attention of Arnold and his colleagues in the Research Department of the Telephone Company.

4967 In passing upon the question of validity as presented by these patents now to be considered, it is necessary to bear in mind that the properties of the tube did not easily yield to the efforts made to lay them bare.

Doubtless the explorations involved repeated experimentation and the successive abandonment of many hypotheses, before conclusions could be announced for which responsibility could be assumed.

If it be thought that such studies necessarily exclude the exercise of the inventive faculty within the contemplation of the patent law as now conceived, then all of these patents might well be declared invalid as failing to disclose invention. That is a responsibility which this court is unwilling to assume for the reason that study, research, and experimentation, to yield success, must involve something more than mere persistence; they must be ordered by understanding and enlightened by intuition and insight of so high an order that invention may come from them. If this view is mistaken, correction need not long be delayed.

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As to the particular patent under examination, it should be said that the specifications portray

the philosophy of the three electrode electron device more completely than any other document which has been offered in evidence. The proclaimed object is to provide tube constructions by which certain desired characteristics of the amplifier may be secured at will; this is accomplished by proportioning the geometrical and electrical relations of the various elements as explained, which probably means that the necessary relations of the grid, filament and the plate had been so established as the result of experimentation that the tubes could be organized for definitely understood purposes by following the teaching of the claims. 4970

It is true that Arnold did not originate the three electrode tube and his contribution to the art of amplification of frequencies by its use might be likened to many of those of the late Thomas A. Edison. That is to say, he perfected, developed, and therefore rendered available, the invention of another, which, but for his research and understanding, might not have come to full fruition. 4971

Of the twenty-five claims stated in the patent, the following are in suit:

> "7. The combination with a thermionic discharge device having a cathode, an anode and a control element, of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and control element being so spaced that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit."

"10. The combination with a thermionic discharge device having a cathode, an anode, and a grid, of an input circuit connected to said cathode and said grid, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said going circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said grid
4973 but out of electrical contact therewith, and said anode being so spaced from said cathode and grid and the said grid being of such coarse mesh that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit."

"13. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit."
4974

Specifically, amplification through the employment of this tube could be of the high voltage type or the high current type, whichever was desired. If the ratio of the output current to the input voltage is high, a power tube is the result.

In order to reach the results announced, Arnold recognized that the internal impedance between the plate and the filament had to be equal to the impedance of the work or output circuit. This is called the theory of matched impedances, and it is not claimed that Arnold was alone in recognizing the necessary applicability of that theory to the effectual operation of these amplifying devices.

It is not proposed to recite the minute details of construction of the tube resulting from the 4976
application of the conclusions arrived at by Arnold.

The defendant relies on *Seibt, No. 1,012,456, Arnold, No. 1,129,943,* and *Colpitts, No. 1,129,959,* and it refers to *Langmuir, No. 1,558,436,* merely because of a reference to the geometric proportions of the tube in the case of *De Forest Radio Co.* v. *General Electric Co.,* 283 U. S. 664. The patent was not otherwise referred to in the hearing of this cause.

Seibt was not dealing with a vacuum tube. He merely applied to his radio-telephone transmit- 4977
ter the recognized principle of matched impedances, through the introduction of resistance into the transmitting medium. It is thought that Seibt made no contribution to the art peculiar to the electron discharge device here involved.

Colpitts, No. 1,129,959, is of questionable status as prior art because the application for that patent was not offered in evidence and so the disclosure therein made has not been revealed. The application was filed April 6, 1914, and the testimony in this record with respect to transcontinental telephony experiments is sufficient to indicate invention by Arnold as early

as January 6, 1914. The file wrapper of this patent contains an affidavit verified by Arnold May 1, 1919, to the effect that he disclosed his invention to Pierce prior to April 6, 1914. As Colpitts was not set up as anticipation, it is thus disposed of.

The *Arnold patent No. 1,129,943* was filed May 28, 1914 (serial number 841569). The application for the patent in suit was filed July 30, 1918, but the caption recites that it is a continuation
4979 in part of application, serial number 841567, filed May 28, 1914, and application, serial number 841568, filed May 28, 1914. In other words, these applications all disclose the inventions of the patent in suit, but the claims were for different aspects thereof. These three claims are not for the tube but for the combination of the tube with the circuit. That combination is not disclosed in the prior art cited, and validity can be defeated only if it is concluded that patentable invention did not underlie the disclosure.

Without repeating what has been said here-
4980 tofore, it is thought that the intellectual process which analyzed the properties of and rendered the three electrode tube selectively available for differing purposes, through organizing its elements and adapting their relations to the circuit described, was of such an order that the status of invention should be accorded to it.

Arnold, No. 1,349,252:

The application for this patent was filed March 20, 1916, and renewed May 16, 1918, and is said to affect the method and means for utilizing thermionic currents; the invention relates to these amplifiers and more particularly to circuit ar-

rangements by which what is called the current voltage characteristic is made to have a desired form; an object is "to repeat or amplify electrical impulses substantially without distortion."

The general purpose is thought to be similar to that announced in *Arnold, No. 1,3[illegible],283,* to accomplish the amplification of current in the output circuit without increasing voltage; to bring this about the internal and external impedances of the same order are maintained.

The purpose is here accomplished by inserting a resistance in the output circuit. The simplicity of the device may have suggested the expediency of reciting in the specifications, in a scientific form, a rather complex exposition of the advantages so obtained. There are nineteen claims of which only one is in suit, namely: 4982

> "15. A thermionic repeater having an input circuit and an output circuit, a source of electromotive force in each of said circuits, said output circuit having an impedance, the magnitude of said electromotive forces and said impedance being such as to cause the output current to vary approximately linearly as the input voltage over a portion of the characteristic curve suitable for efficient operation of the said repeater." 4983

The elaboration of presentation lays an atmosphere of mystery about a step which perhaps may not lend itself to simple or direct exposition; probably the principle intended to be announced is that reproduction of the imposed frequencies can be best accomplished without distortion when there are symmetrical relations be-

tween the input voltage and the output current. If the meaning of the subject-matter has been understood, it is difficult to observe in this patent anything lying beyond the recognized necessity for matched impedances. The application of that general principle, as embodied in Arnold, No. 1,329,283, seems broad enough to comprehend or inevitably suggest the device of this patent.

4985 There may be, as plaintiffs urge, sundry fine-spun scientific distinctions between the teachings of the two patents, but this court has been unable to discover that patentable invention was brought into play by the putting of a resistance in the output circuit to promote efficiency of performance of a thermionic tube organized according to the teachings of the Power Circuit Patent, Arnold, No. 1,329,283.

It is concluded that this patent lacks validity.

Arnold, No. 1,403,475:

4986 This is a division of the original application filed September 3, 1915, and this application was filed November 11, 1920. It has to do with vacuum tube circuits in which a plurality of vacuum tubes function in tandem; the object is to provide an improved circuit connection between the tubes "whereby fluctuations of current in the output circuit of one vacuum tube may be impressed on the input circuit of another." The claims are Nos. 8, 9 and 10, namely:

> "8. In combination a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, and con-

nections for impressing said variations on said electrodes, said connections comprising a series condenser.

"9. In combination a circuit comprising a resistance, a source of direct current and means for producing variations in said current, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser. 4988

"10. In combination, a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, connections for impressing said variations on said electrodes, said connections comprising a series condenser, and a resistance shunt for said input electrodes."

As explained by Mr. Waterman, the patent and drawings reveal a two-stage device comprised of a detector as the first and an amplifier as the second, which are coupled "by a resistance capacity coupling in which the coupling resistance is 25" in the drawing. He traced the current and said: "The alternating current in this case, the audio frequency alternating current, flows from the plate across the filament; thence through the condenser 24 and through the resistance 25 back to the plate. The flow of this current in the resistance 25 creates a difference of potential between the ends of the resistance 25 corresponding exactly to the signal, no matter what the frequency. This characteristic of 4989

the resistance with the voltage across it is independent of the frequency."

The advantage of the resistance capacity coupling is this independence of frequency over "the whole range of voice frequeney handled with practically identical efficiency."

This device permitted the coupling as explained, between a succession of tubes in such a manner that distortion of frequencies was avoided and they were passed on from tube to
4991 tube equally amplified. The record does not indicate any other method whereby this result is accomplished. As a practical matter, the value is particularly recognized in the quality which permits the passing on from one tube to another of very small currents or energies, and the importance of this in the motion picture industry is obvious.

The defendant argues that there was an abandonment of the original claim and that the device was anticipated in Arnold No. 1,129,942. What has been said with reference to the divi-
4992 sional nature of this application from the original which was filed September 3, 1915, disposes of the first objection. As to the second, the issue comes down to this: Does the Arnold patent relied on by the defense (which had for its purpose the exclusion of transformers from amplifiers) disclose a resistance capacity coupling? The defendant's expert, when comparing the two patents, used the following expression: "The only essential difference between this arrangement (referring to Arnold No. 1,129,942) and that shown by the patent in suit is in the substitution of a resistance, No. 25, by the reactance 17, in patent 1,129,942." Since the defendant's

expert regards the difference as essential, it is perhaps unnecessary to pursue this argument further.

It seems that reactance results from the presence of an induction coil or condenser and constitutes a definite kind or form of impedance. The plaintiffs' evidence is persuasive to the effect that the essential difference between the two kinds of coupling is that the earlier one which employs inductance admits of the presence of that form of impedance known as reactance; this 4994
is avoided by the employment of the resistance capacity coupling of the patent whereby frequencies are faithfully reproduced in the successive tubes of the circuit.

It results that this patent must be deemed valid and infringed.

Arnold, No. 1,448,550:

Application filed February 3, 1919, granted March 13, 1923, covering thermionic amplifier circuits.

The application reveals that it is a continua- 4995
tion in part of application, serial No. 59210, filed November 2, 1915, and of application, serial No. 48873, filed September 3, 1915. The defendant asserts in its brief that the plaintiffs made no effort to identify the part constituting continuance; it is not thought that the burden rested upon them to do so.

The invention relates to repeater circuits in which the tube is employed "for receiving comparatively weak incoming impulses and for transmitting them in the same form or in a modified form but with amplified energy."

Apparently this device was developed in con-

nection with repeaters for transcontinental telephony and the patent discusses the high impedance between the grid and the filament; it is said that, when the grid is under negative bias, this impedance is of the order of infinity, because no electrons can flow from the filament to a negative grid.

Apparently this is the price that is paid for the imposition of the negative bias to the grid.

There are two claims in suit:

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"1. The combination of a vacuum discharge repeater of the three-electrode type, an inductive coil conductively connected to the input electrodes of said repeater, and a conductive impedance in shunt to said coil."

"12. The combination of a line, an amplifier in circuit therewith having an input impedance which is practically infinite, and a shunt between said line and said amplifier having an impedance of the order of 500,000 ohms."

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From what is presently understood, the object is to modify the effect of the high impedance from an infinite to a finite value. The practical object resulting from the circuit arrangement of the patent is the avoidance of resonance caused by conditions which are presently so little understood that it is necessary to quote Mr. Waterman's testimony to avoid judicial distortion. Referring to the transformer in the circuit between which and the vacuum tube the resistance is inserted, he says: "Now, it is possible for that transformer acting with the ca-

pacity of the tube to get into a state of * * * resonance wherein at a particular frequency the impedances due to the inductance and to the tube capacity disappear and the transformer becomes enormously receptive to frequencies of that value, so that it is possible for the resonant effect produced to pick out and exaggerate one frequency * * *. The transformer tends to work at a particular frequency and all the powers of an electric designer have to be exercised to get a transformer which will have broad frequency 5000
characteristics. The tendency resulting from the feed back just mentioned is because the transformer is to be selected for particular frequencies. All of these effects are cured or minimized by putting across the secondary of the input transformer a resistance chosen of proper value to effect the cure of the particular defect experienced.

"The tube then looks to the transformer and the incoming line like a definite load of that value selected with a desired end to be attained and used, and this patent therefore is known as 5001
the Definite Impedance Patent. * * * The resistance serves to prevent reflection by absorbing the energy that might otherwise be reflected. It serves to prevent or minimize the resonance effect by absorbing the energy which would otherwise go into the resonance phenomenon. It prevents or minimizes the effect of feed back from the plate to the input circuit, by again absorbing the energy fed back."

The defendant relies upon certain earlier patents and particularly alleged complete anticipation, lack of patentable novelty, and a double patenting.

Possibly the object accomplished by the circuit arrangement disclosed, may be a preliminary step to the ultimate matching of impedances, but nothing in the testimony or the patent so discloses. The showing apparently is that the input impedance must be transposed from an infinite to a finite aspect in order that the tube may function, and Arnold seems to have been the first, in point of time, to devise a method for meeting this known requirement; the problem
5003 was recognized as an obstacle to transcontinental telephony, and the repeater development necessary thereto; Arnold's solution of the problem, as related by the witness Kendall, is convincing as to dates, because he was fortified by records.

The earliest filing date named in any of the five patents upon which defendant relies is April 6, 1914, as to Colpitts No. 1,129,959.

Kendall is a persuasive witness to carry Arnold's date of invention to the early part of March, 1914. It should be noted that one of the other patents relied on, that of Van der Bijl,
5004 filed August 15, 1915, was granted to one who was then an associate of Arnold in the research work to which reference has been made.

Circuits employing the repeater embodied in this invention were in service in Pittsburgh experimentally on March 10th and 11th, and in Philadelphia on March 23, 1914. This testimony is to the same effect as the affidavits of Arnold appearing in the various file wrappers as to his dates of invention.

It is concluded that the defendant cannot rely upon the art as shown to deprive Arnold of priority of invention.

As to the assertion that claim 12 is devoid of

patentable novelty "as merely being for specific electrical values, any choice of which being exhausted by the teachings of the prior art that the shunted impedance may be varied to any desired value," it is to be said:

As to the teachings of the prior art as alleged, it is thought that there are none; in view of which the mere assignment to the impedance of the order of 500,000 ohms in claim '12 is probably not so specific as to render the claim invalid. 5006

So far as the assertion of double patenting is concerned, attention is directed to claims 16, 17 and 24 of Arnold patent No. 1,329,283, where it is said that the same invention in different language is disclosed. Claim 16 is cited as an illustration. This is the Power Circuit Patent, *supra*, and claim 16 reads as follows:

> "16. Means for amplifying energy without substantial voltage amplification, comprising a vacuum discharge tube having an input and an output circuit, a source of 5007 variable energy to be amplified connected in said input circuit, and a translating device to which the amplified energy is delivered connected in said output circuit."

It is argued that the words "a source of variable energy to be amplified connected in said input circuit" embodied the concept of an impedance connected in shunt in the input circuit and thus there is double patenting. It is thought that the expression quoted from the earlier Arnold patent differs from the claim relied upon, in that the reference to a source of variable energy in

Arnold No. 1,329,283 may mean a number of things, while the device in suit is limited to a high impedance connected across the input transformer. It may be that the scope of the earlier patent is broad enough to envisage what is claimed in the later one, but certainly the invention stated in it cannot be said to involve the same conception as that portrayed in the Power Circuit Patent; in other words, the defendant has failed to meet the requirements to prove
5009 double patenting. The defense has been considered on its merits in spite of the fact that it was not pleaded. The instant patent is held to be valid and infringed.

Arnold, No. 1,465,332:

This is a second divisional application. The original was filed September 3, 1915, and the first divisional application thereon was filed March 26, 1919, and the second, upon which this patent was granted, was filed August 28, 1920. It relates to arrangements for supplying space cur-
5010 rent to vacuum tube amplifiers and an object is to provide means whereby a plurality of vacuum tubes to be used as repeaters or amplifiers may be supplied with space current from a single source, but in such a manner that current changes in one tube due to signals being repeated cannot be impressed upon another tube through said source.

Stated plainly, what is embodied is a circuit arrangement including a plurality of tubes each of which amplifies into the following tube; operation from a common source of space current is rendered possible and at the same time the amplifying current flowing in the tube is not per-

mitted to affect the circuit of the preceding tube through regeneration so as to distort the signals.

As pointed out in *De Forest Radio Co.* v. *General Electric Co.*, 283 U. S. 664 at 671, the output current depends on the intensity of the electron stream from the filament to the plate, which in turn is governed by the voltage of the current passing to the filament; if that is intense enough to "force all the electrons emitted by the filament to pass from filament to plate, increase in the voltage at the filament will not 5012 produce an increase in current in the loud speaker circuit and the tube is then said to be saturated." As successful operation of the tube depends upon the response of the loud speaker current to changes in voltage effected by the voice or input current, the tube is most efficiently operated at a voltage of a range below saturation, and a current within this range is known as the 'space current'."

The space current is supposedly of dual constituency, namely, the direct current generated by the plate battery, upon which is superimposed 5013 the alternating voltage carrying the incoming signals.

In the employment of a single source of current to supply the plate electrodes where there are a number of tubes in an assembly, some of the circuit is common to all of the tubes, which leads to interaction between them, which will be transmitted to all of the tubes.

A weakness of the common source system was that it provided a means for later tubes in the assembly to feed back into the earlier ones, in turn setting up regeneration. If that takes place, the amplified signals in one tube flow in

the plate circuit of the preceding tube, and that will affect the input circuit of the tube from which it emerged. To overcome this tendency, the filter system of the patent in suit was devised. Claims 1, 3, 5, 8, 10 and 11 are involved:

"1. In combination, a plurality of vacuum tube repeaters, a common source of space current for said repeaters, the circuit between one of said repeaters and said source
5015 comprising series inductance, and a path comprising capacity bridged across said circuit between said source and said repeater."

"3. In combination, a plurality of vacuum tube repeaters, said repeaters being connected in multiple to a common source of space current, and means to prevent alternating currents from one of said repeaters from flowing in the portion of the space current circuit common to said repeaters."

5016 "5. In a multi-stage amplifier, a plurality of vacuum tubes connected in tandem, a common source of space current for said tubes, branch circuits connecting said source and said tubes, and a filter comprising series inductance in one of said circuits and a path containing capacity bridged across the circuit between one of said tubes and said source."

"8. In combination, a plurality of vacuum tube translating devices, a common source of current for energizing said tubes, and a path comprising capacity bridged across

each of the circuits connecting said tubes to said source."

"10. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers in succession from the last to the first of said amplifiers, and filter connections 5018 between successive amplifiers of the series."

"11. The combination in an amplifying system of a series of electron discharge amplifiers connected in cascade, each of said amplifiers having plate and grid circuits, a common source of current for supplying current to the plate circuits of all of said amplifiers, and filter connections between successive amplifiers of the series."

It has been explained that the filters make it 5019 possible to employ the common plate supply of direct current for all the tubes without sacrifice of the alternating or signal current constituency of the space current in the output circuits. The demonstration of the philosophy of this circuit arrangement offered on behalf of the plaintiffs is not questioned, and it is common ground that the desired purpose necessarily employs resistance for dealing with direct current and impedance or reactance for the alternating current. As the defendant's counsel stated (speaking of another patent): "In the output circuit of a vacuum tube there is both direct current and alternating cur-

rent. You have to have a path of travel for both, a path of travel for the alternating current is through the condenser shunting around resistance 15 (Weagant No. 1,384,108) to the condensers for the reactance, depending on their value and impedance for alternating current."

As defendant must be taken to have conceded the adequacy of the device of this patent to accomplish its avowed purpose, the only possibly successful method of attack upon the patent was
5021 to assert that it had been anticipated, as the defendant says, by Arnold No. 1,129,942. Figure 6 of that patent does present a common battery for all the plates but, as Arnold deposed in the file wrapper of this patent, in order to avoid the same objection made by the Examiner, that was an immaterial element of that patent. The further point of resemblance is said to be the inductance coils shown in figure 6 which are coupling elements according to the defendant's expert, Cloud.

His statement is this: "A simple statement
5022 would be in this case, by means of a choke we hold back alternating current frequency and by means of a condenser we by-pass them (*sic*) in the direction we wish them to go. We keep them out of one portion of the circuit and pass them into another."

The plaintiffs' testimony, which is uncontradicted, as to this narrow issue, is that there is no such inductance shown in the prior Arnold patent *as a filter means to prevent oscillation in the system.* The argument is made that the office of the inductance coils 17 in figure 6 of Arnold No. 1,129,942 is to permit alternating current to pass through them while the impedances

21 and 28 in this patent are availed of to prevent that very thing. Mr. Waterman states it this way:

> "And the interposition of the choke or inductance coil 28 is for the purpose also of imposing a difficulty in the path of the alternating current from flowing in the wire that leads back to the battery."

It appears that coil 21 is also a choke or inductance coil. The importance of these two elements for the purpose stated is somewhat minimized by the following passage from the same witness' deposition: 5024

> "Those are the means adopted to make practical the operation of the tube from a common source. It is commonly found that the mere use of the condensers is enough, or even one condenser is enough, sometimes just one choke is used, maybe in either of the positions shown; sometimes the whole combination is used, according to the severity of the conditions that are imposed." 5025

It will thus be seen that, as to these particular choke coils, the patent can scarcely be regarded of major importance, but it is not deemed to have been sufficiently discredited by the testimony offered for the defendant, as contrasted with argument, to overcome the presumption of validity which is fortified by the prior examination of the cited patent in the Patent Office; allowance was had over that patent, as to the effect of which, to fortify the presumption of val-

idity, see *Ensign Carburetor Co.* v. *Zenith-Detroit Corporation*, 36 Fed. (2d) 684.

Validity is found.

Arnold, No. 1,520,994:

Original application filed September 3, 1915, of which this is a division, filed March 28, 1919.

This patent has to do with an arrangement for a method of varying the ratio of amplification of an electron discharge amplifier, and the
5027 purpose is accomplished (without varying the impedance presented by the amplifier as a whole to the impulses which are to be amplified) by the use of an impedance shunted across the terminals of the secondary of the transformer used to step up the voltage of the incoming currents.

The filament is connected to one end of this impedance and a connection is made from the grid by means of an adjustable contact to a desired point on the impedance; by this means the proportionate part of the potential drop across the impedance which is applied between the grid
5028 and the filament varies the amplification in the output circuit. Claims 1 and 4 are involved, namely:

> "1. In combination, an electron discharge relay comprising an anode, a cathode and a control electrode, a circuit containing a source of alternating current electric impulses to be relayed, an impedance in shunt to said source, and means comprising a contact movable along said impedance for effectively connecting said control electrode and said cathode across an adjustable proportion of the whole of the said impedance."

"4. The combination of an incoming line, an amplifier having a cathode and an anode, means for supplying a space current between said electrodes, said amplifier having a grid electrode for controlling such space current, means for making said grid negative with respect to said cathode, and means between said line and the input electrodes for making the impedance of said amplifier as seen from said line substantially of a constant value, said last mentioned means comprising a potentiometer arrangement including an impedance and a contact movable along said impedance for varying the voltage supplied to said input electrodes."

There is no dispute as to the nature of the device or the way it operates. The incoming signal enters at one end of the amplifier and as amplified it emerges from the other end. The control of the latter may be desired through the employment of a device which does not disturb the operating characteristics of the entire apparatus so that accuracy of reproduction of the incoming signal is preserved. This patent accomplishes the purpose by means of the potentiometer, voltage being driven off the voltage plate to the grid of the second tube. The resistance is connected across the secondary of the intermediate transformer and "the variable quantity of the voltage expended in that resistance is applied to the grid, the grid is negatively biased and therefore its control has no effect whatever on the circuits to disturb their performance."

The foregoing paraphrase and quotation are from Mr. Waterman's testimony. Elsewhere he

refers to the potentiometer as here used as follows: "It is commonly known also as a voltage divider."

The device permits control of the alternating power voltage of the secondary of the intermediate transformer which is distributed along resistance 25; by removing the point 26 (the potentiometer) "any part of it may be taken off because the filament connection is fastened to the bottom, therefore, if point 26 were to be cleared
5033 at the bottom end, then no voltage at all would be taken to the grid and that would have no output. If we moved it to the top, then, we would have maximum output. Any output between can be attained."

The matter to be decided comes down to this: Did the application of a potentiometer, which the plaintiffs' testimony shows to have been one of the oldest of electrical tools, to this particular use, involve patentable invention?

It is thought that the answer should be in the negative. It is probably true that this particular
5034 use of this well known device as an adjustable contact to high impedance across the input circuit, the negative grid bias being present, did not happen to occur to others skilled in the art at the time that this patent was applied for, and yet the entire testimony creates the impression that it merely involved the selection of a well known means to accomplish a necessary purpose which falls short of indicating the exercise of the inventive faculty. For this reason, it is concluded that the patent lacks validity.

There remains for consideration the contention that five of the Arnold patents are invalid because the evidence discloses that transcontinen-

tal telephone service available to the public in January of 1915, involved the use by the plaintiffs of the inventions described in some or all of these patents, and that the latter were granted more than two years subsequent to this commercial use and therefore section 4886 of the Revised Statutes constitutes a statutory bar to their validity. It is said that the plaintiffs have offered no evidence from which the conclusion could be drawn that this delay is excusable.

The patents so challenged are: 5036

Arnold, No. 1,329,383 (Power Circuit) application filed July 30, 1918.

Arnold, No. 1,403,475 (Resistance Capacity Coupling) application filed November 11, 1920.

Arnold, No. 1,448,550 (Definite Input Impedance) application filed February 3, 1919.

Arnold, No. 1,465,332 (Common Plate Supply) application filed August 28, 1920.

Arnold, No. 1,520,994 (Gain Control) application filed March 28, 1919.

The argument is mistakenly directed as to members 2 and 4, the Resistance Capacity Coupling and the Common Plate Supply patents, because the testimony does not disclose that they were employed in the transcontinental telephone service. 5037

As to the remaining three:

Arnold, No. 1,329,383, the Power Circuit patent, was not a divisional application but a continuing application seemingly disclosed in two earlier filed applications pending with the continuing application, namely, serial No. 841,567 filed May 28, 1914, and serial No. 841,568 filed May 28, 1914. The caption of this patent so discloses.

Arnold, No. 1,448,550, the Definite Input Impedance patent, recites that it is a continuation in part of application serial No. 59,210 filed November 2, 1915, and of application serial No. 48,873 filed September 3, 1915, said to disclose the invention.

The defendant asserts that there is an implied abandonment of the earlier filed application, by which assertion it seeks to support its argument that the statutory bar applies. On this subject
5039 Walker, 6th Edition, page 248, reads:

> "When the two applications are continuous the two years' public use or sale which may avoid the patent must be reckoned from the presentation of the first application, and not from the filing of subsequent applications or amendments." (Citing *Hayes-Young Tie Plate Co.* v. *St. Louis Transit Co.*, 137 Fed. 80; *Victor Talking Mach. Co.* v. *American Graphophone Co.*, 145 Fed. 350; *Corrington* v. *Westinghouse Air Brake Co.*, 178 Fed. 711.)

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The citations seem to fortify the text.

See also:

> *American Tri-Ergon Corporation* v. *Paramount Publix Corporation*, 71 Fed. (2d) 153, at 157.

Arnold, No. 1,530,994, the Gain Control patent: The specifications state that this is divided out of an application serial No. 48,873 filed September 3, 1915, which apparently discloses the subject-matter.

The important aspect of the argument lies in the fact that it is not supported by any equitable

onsiderations because the public use to which he defendant refers is the plaintiffs' own use, ot that of any other inventor.

Naturally the defendant did not use any of hese inventions until the year 1929, and the de- ision upon which it relies, namely, *Westing- ouse Electric & Manufacturing Co.* v. *Jeffrey- DeWitt Insulator Co.*, 22 Fed. (2d) 277, is whol- y unlike this controversy in that most important espect. It is true that the court there says that ecent decisions of the Supreme Court have mod- 5042 ied the earlier rule respecting a divisional pat- nt, which rule was that in the absence of laches r estoppel of intervening rights, the divisional atent related to the date of filing the original pplication. The Supreme Court, however, in *Vebster Electric Co.* v. *Splitdorf Electrical Co.*, 64 U. S. 463, at 471, in commenting upon the ule of decision in *Chapman* v. *Wintroath*, 252 . S. 126, says:

"But a reading of the entire opinion dem- onstrates that this conclusion (that a hard 5043 and fast time limit of two years is to be applied in every case of a divisional applica- tion) is erroneous. The Court proceeds to say that divisional applications are not to be dealt with in a hostile spirit, but are to be 'favored to the extent that where an in- vention clearly disclosed in an application • • • is not claimed therein but is subse- quently claimed in another application, the original will be deemed a constructive reduc- tion of the invention to practice and the later one will be given the filing date of the earlier, with all of its priority of right.'

> * * *; and, while it is not said in terms, the plain import of the citation of and reliance upon these cases (those cited) is that the effect of the two years' delay, as recognized in those cases, may be overcome where it 'is accounted for and excused by special circumstances, which show it to have been not unreasonable'; and, properly understood, there is nothing in the opinion to the contrary.
>
> 5045 "Our conclusion, therefore, is that in cases involving laches, equitable estoppel or intervening private or public rights, the two-year time limit *prima facie* applies to divisional applications and can only be avoided by proof of special circumstances justifying a longer delay. In other words, we follow in that respect the analogy furnished by the patent reissue cases."

The statute upon which the defendant relies was not involved in the *Webster Electric Co.* 5046 case, but it was referred to for the sake of analogy.

Clearly the court considers the equitable aspect of any such controversy, and there is authority which will here be followed, to the effect that the plaintiffs' own public use more than two years prior to the date of the filing of a divisional application, but within two years of the date of the application from which the division was made, does not call into operation the statute upon which the defendant relies. That authority is *American Chain Co.* v. *Franklin New York Co.*, 34 Fed. (2d) 551, in which there is a quotation from Judge Hough's opinion in the

case of *American Laundry Machinery Co.* v. *Prosperity Co.*, 295 Fed. 819, which seems to furnish a complete answer to the defendant's position. The *American Chain Co.* case, has not been adversely affected by any subsequent decision.

Decree for the plaintiffs as prayed, to be settled on notice.

If the foregoing is not deemed a sufficient compliance with Equity Rule 70½, Findings may be settled in connection with the decree in accord- 5048
ance with the foregoing.

M. W. B.,
U. S. D. J.

Decree (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-175.

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This cause having come on to be heard at this term and was argued by counsel; and thereupon,

upon consideration thereof, it is ORDERED, ADJUDGED and DECREED as follows:

1. That plaintiff, American Telephone and Telegraph Company, is the owner of the following Letters Patent in suit:

Name	*Number*	*Granted*
Arnold	1,329,283	Jan. 27, 1920
Arnold	1,349,252	Aug. 10, 1920
5051 Arnold	1,448,550	Mar. 13, 1923
Arnold	1,520,994	Dec. 30, 1924

2. That plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products Company, Inc., are exclusive licensees under each of said Letters Patent in the sound picture field and are proper parties plaintiff.

3. That claims 7, 10 and 13 of said Letters Patent No. 1,329,283 and claims 1 and 12 of said Letters Patent No. 1,448,550, are good and valid
5052 in law.

4. That defendant, General Talking Pictures Corporation, has infringed each of the said claims of said Letters Patent Nos. 1,329,283 and 1,448,550 by leasing to motion picture theatre owners in the United States, for use in reproducing talking motion pictures, vacuum tubes and vacuum tube amplifiers, said vacuum tubes and vacuum tube amplifiers being identified and diagrammatically illustrated in Plaintiffs' Exhibit 2 in evidence.

5. That the said acts of the defendant were not licensed under any of said Letters Patent in

suit as alleged in either paragraphs 6 or 7 of the answer, or as otherwise contended by the defendant in this case.

6. That a perpetual injunction issue out of and under the seal of this Court enjoining and restraining said defendant, its associates, agents, attorneys, servants, workmen, employees and each of them, and all those in privity therewith, under the pains and penalties which may fall in case of disobedience, from infringing or contributing to the infringement of claims 7, 10 and 13 of said Letters Patent No. 1,329,283 and claims 1 and 12 of said Letters Patent No. 1,448,550, and particularly from doing the acts held to be an infringement in paragraph 4 hereof, and from otherwise infringing or contributing to the infringement of said Letters Patent. 5054

7. That defendant account for and pay over to plaintiffs all gains and profits that have accrued or been earned or received by the defendant by reason of its said infringement, and all gains and profits that would have accrued to the plaintiffs but for the unlawful acts of the defendant, and all damages plaintiffs have sustained thereby; that this cause be referred to Dean S. Edmonds, Esq., a special master of this Court, to take and state an account of said profits, savings, advantages and damages, and to report thereon to this Court; and that the defendant, its associates, agents, attorneys, servants, workmen and employees and each of them, and all those in privity therewith, are hereby directed to attend before the said Master from time to time as required, and to produce such 5055

books, other documents and exhibits as they may be directed to produce, and to submit to such oral or other examination as the Master may direct.

8. That the plaintiffs recover from the defendant three-fourth (¾) of plaintiffs' total costs in this and the other two suits, Equity Nos. 50-177 and 50-178, which were tried with this suit.

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9. That claim 15 of said Letters Patent No. 1,349,252 and claims 1 and 4 of said Letters Patent No. 1,520,994, are invalid and void; and the bill of complaint be and the same is hereby dismissed as to said Letters Patent.

MORTIMER W. BYERS,
United States District Judge
Sitting by Special Designation.

Dated: 10/27/36.

5058

Approved as to form.

(Sd.) SAMUEL E. DARBY, JR.,
Counsel for Defendant.

(Sd.) HENRY R. ASHTON,
Counsel for Plaintiffs.

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Decree (Equity No. 50-177).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-177.

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This cause having come on to be heard at this term and was argued by counsel; and thereupon, upon consideration thereof, it is ORDERED, ADJUDGED and DECREED as follows:

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1. That plaintiff, American Telephone and Telegraph Company, is the owner of the following Letters Patent in suit:

Name	*Number*	*Granted*
Lowenstein	1,231,764	July 3, 1917
Mathes	1,426,754	Aug. 22, 1922

2. That plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products Company, Inc., are exclusive licensees under each of said Letters Patent in the sound picture field and are proper parties plaintiff.

3. That claims 1, 2, 4, 5, 6 and 7 of said Letters Patent No. 1,231,764 and claim 8 of said Letters Patent No. 1,426,754, are good and valid in law.

4. That defendant, General Talking Pictures Corporation, has infringed each of the said claims of said Letters Patent Nos. 1,231,764 and 1,426,754 by leasing to motion picture theatre owners in the United States, for use in reproducing talking motion pictures, vacuum tubes and vacuum tube amplifiers, said vacuum tubes
5063 and vacuum tube amplifiers being identified and diagrammatically illustrated in Plaintiffs' Exhibit 2 in evidence.

5. That the said acts of the defendant were not licensed under any of said Letters Patent in suit as alleged in either paragraphs 6 or 7 of the answer or as otherwise contended by the defendant in this case.

6. That a perpetual injunction issue out of and under the seal of this Court enjoining and restraining said defendant, its associates, agents,
5064 attorneys, servants, workmen, employees and each of them, and all those in privity therewith, under the pains and penalties which may fall in case of disobedience from infringing or contributing to the infringement of claim 8 of said Letters Patent No. 1,426,754 and particularly from doing the acts held to be an infringement in paragraph 4 hereof, and from otherwise infringing or contributing to the infringement of said Letters Patent.

7. That defendant account for and pay over to plaintiffs all gains and profits that have accrued or been earned or received by the defendant by

reason of its said infringement, and all gains and profits that would have accrued to the plaintiffs but for the unlawful acts of the defendant, and all damages plaintiffs have sustained thereby, that this cause be referred to Dean S. Edmonds, Esq., a special master of this Court, to take and state an account of said profits, savings, advantages and damages, and to report thereon to this Court; and that the defendant, its associates, agents, attorneys, servants, workmen and employees and each of them, and all those in 5066
privity therewith, are hereby directed to attend before the said Master from time to time as required, and to produce such books, other documents and exhibits as they may be directed to produce, and to submit to such oral or other examination as the Master may direct.

8. That the plaintiffs recover from the defendant three-fourths (¾) of plaintiffs' total costs in this and the other two suits, Equity Nos. 50-175 and 50-178, which were tried with this suit. 5067

MORTIMER W. BYRNS,
United States District Judge
Sitting by Special Designation.

Dated: 10/27/36.

Approved as to form.

(Sd.) SAMUEL E. DARBY, JR.,
Counsel for Defendant.

(Sd.) HENRY R. ASHTON,
Counsel for Plaintiffs.

5068

Decree (Equity No. 50-178).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-178.

5069

This cause having come on to be heard at this term and was argued by counsel; and thereupon, upon consideration thereof, it is ORDERED, ADJUDGED and DECREED as follows:

5070

1. That plaintiff, American Telephone and Telegraph Company, is the owner of the following Letters Patent in suit:

Name	*Number*	*Granted*
Arnold	1,403,475	Jan. 17, 1922
Arnold	1,465,332	Aug. 21, 1923

2. That plaintiffs, Western Electric Company, Incorporated, and Electrical Research Products Company, Inc., are exclusive licensees under each of said Letters Patent in the sound picture field and are proper parties plaintiff.

3. That claims 8, 9 and 10 of said Letters Patent No. 1,403,475 and claims 1, 3, 5, 8, 10 and 11 of said Letters Patent No. 1,465,332, are good and valid in law.

4. That defendant, General Talking Pictures Corporation, has infringed each of the said claims of said Letters Patent Nos. 1,403,475 and 1,465,332 by leasing to motion picture theatre owners in the United States, for use in reproducing talking motion pictures, vacuum tubes and vacuum tube amplifiers, said vacuum tubes and vacuum tube amplifiers being identified and diagramatically illustrated in Plaintiffs' Exhibit 2 in evidence. 5072

5. That the said acts of the defendant were not licensed under any of said Letters Patent in suit as alleged in either paragraphs 6 or 7 of the answer, or as otherwise contended by the defendant in this case.

6. That a perpetual injunction issue out of and under the seal of this Court enjoining and restraining said defendant, its associates, agents, attorneys, servants, workmen, employees and each of them, and all those in privity therewith, under the pains and penalties which may fall in case of disobedience from infringing or contributing to the infringement of claims 8, 9 and 10 of said Letters Patent No. 1,403,475 and claims 1, 3, 5, 8, 10 and 11 of said Letters Patent No. 1,465,382, and particularly from doing the acts held to be an infringement in paragraph 4 hereof, and from otherwise infringing or contributing to the infringement of said Letters Patent. 5073

5074 *Decree (Equity No. 50-178).*

7. That defendant account for and pay over to plaintiffs all gains and profits that have accrued or been earned or received by the defendant by reason of its said infringement, and all gains and profits that would have accrued to the plaintiffs but for the unlawful acts of the defendant, and all damages plaintiffs have sustained thereby; that this cause be referred to Dean S. Edmonds, Esq., a special master of this Court, to take and state an account of said profits, savings, advantages and damages, and to report thereon to this Court; and that the defendant, its associates, agents, attorneys, servants, workmen and employees and each of them, and all those in privity therewith, are hereby directed to attend before the said Master from time to time as required, and to produce such books, other documents and exhibits as they may be directed to produce, and to submit to such oral or other examination as the Master may direct.

5075

8. That the plaintiffs recover from the defendant three-fourths (¾) of plaintiffs' total costs in this and the other two suits, Equity Nos. 50-175 and 50-177, which were tried with this suit.

5076

MORTIMER W. BYERS,
United States District Judge
Sitting by Special Designation.

Dated: 10/27/36.

Approved as to form.

(Sd.) SAMUEL E. DARBY, JR.,
Counsel for Defendant.

(Sd.) HENRY R. ASHTON,
Counsel for Plaintiffs.

5077

Stipulation and Order in Three Suits Re Findings of Fact and Conclusions of Law.

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity Nos. 50-175, 50-177, 50-178.

5078

It is hereby stipulated and agreed by and between the parties hereto that the opinion of the Court in these cases shall be deemed sufficient findings of fact and conclusions of law, in compliance with Equity Rule 70-½ and RULE XVIII of the Equity Rules of this Court.

5079

SAMUEL E. DARBY, JR.,
Counsel for Defendant.

HENRY R. ASHTON,
Counsel for Plaintiffs.

It is so ordered.

MORTIMER W. BYERS,
United States District Judge.

October 27, 1936.

5080

Supersedeas Order.

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity Nos. 50-175, 50-177, 50-178.

5081

These three causes having come on to be heard on defendant's motion for an order staying the issuance of injunctions and were argued by counsel and thereupon, upon consideration thereof, it is ORDERED

5082

That the issuance of the injunctions provided for in the decrees of this Court be and the same is hereby stayed twenty (20) days from the date hereof; and that providing appeals are duly taken by the defendant from the said decrees to the United States Circuit Court of Appeals for the Second Circuit within the said twenty (20) days, and are regularly prosecuted, the issuance of the said injunctions shall further be stayed until the decision by the said Court of said appeals, upon the conditions (1) that the defendant shall file a bond with adequate surety in the amount of Ten Thousand ($10,000.00) Dollars

conditioned to reimburse the plaintiffs for all costs which may be awarded the plaintiffs in this Court and in the Court of Appeals, and for all profits, gains and advantages and damages which may eventually be adjudged to be due the plaintiffs from the defendant by reason of its infringement of the claims in suit of Letters Patent Nos. 1,329,263, 1,448,550, 1,231,764, 1,427,754, 1,403,475 and 1,465,332; (2) that within the said twenty (20) days defendant file with the Clerk of this Court, and furnish plaintiffs' counsel a copy, an affidavit executed by an officer of the defendant, setting forth year by year the number of infringing amplifiers which have been manufactured, used, sold, leased or otherwise furnished by the defendant since its incorporation, the number of such amplifiers which are still in use, and the number of such amplifiers which the defendant has in its possession or under its control; (3) that the defendant not sell, lease or otherwise dispose of until further order of this Court any of the said amplifiers which it now has in its possession or under its control.

MORTIMER W. BYERS,
United States District Judge.

Dated, Oct. 27, 1936.

Approved as to Form:

DARBY & DARBY,
Counsel for Defendant.

HENRY R. ASHTON,
Counsel for Plaintiffs.

5086 **Defendant's Petition for Appeal (Three Suits).**

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. 5087 GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity Nos. 50/175, 50/177, 50/178.

The above named defendant, General Talking Pictures Corporation, conceiving itself aggrieved by the interlocutory decree entered herein on October 28, 1936, does hereby appeal from said decree to the United States Circuit Court of Appeals for the Second Circuit for the reasons specified in the assignment of errors which is 5088 filed herewith; and it prays that this appeal may be allowed and citation granted, directed to the above named plaintiffs, Western Electric Company, Incorporated, Electrical Research Products, Inc., and American Telephone and Telegraph Company, demanding them to appear before the United States Circuit Court of Appeals for the Second Circuit to do and receive what may appertain to justice to be done in the premises; and asks that a transcript of the pleadings, proceedings, testimony, exhibits, and orders, together with a copy of the opinion of this Court filed in this cause upon which said decree was

entered, duly authenticated by the Clerk of the Court, be transmitted to the United States Circuit Court of Appeals for the Second Circuit under the rules and statutes in such cases made and provided.

GENERAL TALKING PICTURES CORPORATION,
By (S) DARBY & DARBY,
Solicitors for Defendant.

5090

Dated, New York, N. Y., November 13, 1936.

Defendant's Order Allowing Appeal (Three Suits).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity Nos. 50/175, 50/177, 50/178.

5091

AND NOW, to wit: this 13th day of November, 1936, upon consideration of the annexed peti-

tion for appeal in the above entitled cause, it is, upon motion by Darby & Darby, solicitors for petitioner,

ORDERED by the Court that the appeal of the defendant, General Talking Pictures Corporation, prayed for therein be and is hereby allowed.

(S) WM. BONDY,
U. S. D. J.

5093

Defendant's Assignment of Errors (Three Suits).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

5094

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	Equity Nos. 50/175, 50/177, 50/178.

GENERAL TALKING PICTURES CORPORATION, in the above entitled suit, conceiving itself aggrieved by the decree entered therein on the 28th

day of October, 1936, now appearing by its counsel, presents, with the accompanying petition for appeal from said decree, the following assignment of errors:

1. The Trial Court erred in sustaining the bill of complaint and in decreeing an injunction and accounting herein.

2. The Trial Court erred in failing to dismiss 5096
the bill herein and in not entering a decree in favor of the defendant.

3. The Trial Court erred in failing to enter a decree adjudging that the defendant in acquiring equipment in the open market manufactured by a licensee of the plaintiffs under the patents in suit, acquired the right or license under said patents, insofar as that equipment is concerned, to use the equipment for any purpose for which it might be utilized.

4. The Trial Court erred in holding that the 5097
defendant in acquiring equipment in the open market manufactured by a licensee of the plaintiffs under the patents in suit, did not acquire the right or a license under said patents, insofar as that equipment is concerned, to use the equipment for any purpose for which it might be utilized.

5. The Trial Court erred in failing to enter a decree adjudging that a license notice attached to the equipment purchased by the defendant from a manufacturer licensed by the plaintiffs

to manufacture and sell said equipment under the patents in suit restricting the use to which said apparatus may be put, is of no legal effect in restricting the use to which the defendant could put the apparatus so purchased.

6. The Trial Court erred in holding that a license notice attached to the equipment purchased by the defendant from a manufacturer
5099 licensed by the plaintiffs to manufacture and sell said equipment under the patents in suit, restricting the use to which said apparatus may be put, is legally effective in restricting the use to which the defendant could put the apparatus so purchased.

7. The Trial Court erred in failing to enter a decree adjudging that the plaintiffs had ratified or acquiesced in the sale by their licensees of the apparatus and equipment sold to the defendant for the use to which the defendant
5100 intended to put the said apparatus and were estopped from maintaining the suit or receiving the relief prayed for in the bill of complaint herein.

8. The Trial Court erred in holding that the plaintiffs did not ratify or acquiesce in the sale by their licensee of the apparatus and equipment sold to the defendant for the use to which the defendant intended to put the said apparatus, and were not estopped from maintaining the suit or receiving the relief prayed for in the bill of complaint herein.

Defendant's Assignment of Errors (Three Suits).

9. The Trial Court erred in not holding that the plaintiffs had waived all relief by accepting royalties on the allegedly infringing sales to the defendant after the present suit was commenced and retaining such royalties for more than a year with full knowledge of the facts.

10. The Trial Court erred in not holding that by acquiring vacuum tubes in the open market manufactured by plaintiffs' licensees defendant acquired the right to use the tubes for their intended use in connection with the allegedly infringing amplifiers purchased by defendant from other licensees of plaintiffs whereby defendant was licensed to use the combination of tubes and circuits of each of the patents in suit.

11. The Trial Court erred in entering a decree adjudging the specified claims of the following patents to be valid:

Lowenstein	#1,231,764—claims 1, 2, 4, 5, 6, and 7.	
Mathes	1,426,754—claim 8.	
Arnold	1,329,283—claims 7, 10 and 13.	
Arnold	1,403,475—claims 8, 9 and 10.	
Arnold	1,465,332—claims 1, 3, 5, 8, 10 and 11.	
Arnold	1,448,550—claims 1 and 12.	

12. The Trial Court erred in failing to enter a decree adjudging the said claims of the said patents to be invalid as anticipated or wanting in patentable novelty or because of statutory bar.

5104 *Defendant's Statement as to Appeal Bond and Citation.*

13. The Trial Court erred in entering a decree adjudging that the defendant infringed the said claims of the said patents.

WHEREFORE, the defendant prays that the decree of the said District Court of the United States for the Southern District of New York may be corrected and reversed.

5105 GENERAL TALKING PICTURES CORPORATION,
By (s) DARBY & DARBY,
Solicitors for Defendant.

Dated: New York, N. Y., November 13, 1936.

Defendant's Statement as to Supersedeas Bond.

Defendant submitted a supersedeas bond in the sum of $10,000.

5106

Defendant's Statement as to Appeal Bond and Citation.

Defendant submitted an appeal bond in the sum of $250. which was approved and filed, and a citation in the suits was issued on November 13, 1936, and served on November 16, 1936.

5107

Plaintiffs' Petition for Appeal (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-175.

5108

The above named plaintiffs, Western Electric Company, Incorporated, Electrical Research Products, Inc., and American Telephone and Telegraph Company, considering themselves aggrieved by the decree made and entered herein on the 27th day of October, 1936, do hereby appeal from so much of the said decree as adjudged and decreed claims 1 and 4 of Arnold Letters Patent No. 1,520,994 invalid for the reasons specified in the assignment of errors filed herewith, and they pray that this appeal may be allowed and a citation granted directed to the above named defendant, General Talking Pictures Corporation, commanding it to appear before the United States Circuit Court of Appeals for the Second Circuit, to do and receive what may appertain to justice to be done in the premises, and that a transcript of the record,

5109

proceedings and exhibits on which the said decree was made may be duly authenticated and sent to the United States Circuit Court of Appeals for the Second Circuit.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

By HENRY R. ASHTON,

5111 Counsel for Plaintiffs-Appellants.

Dated: November 16, 1936.

Allowance of Appeal.

The foregoing appeal is allowed as prayed for and the Clerk of this Court is directed to issue a citation to the said defendant and to certify the record accordingly.

5112

Dated: 11/17/36.

JNO. C. KNOX,
United States District Judge.

Service hereof acknowledged this day of November, 1936.

DARBY & DARBY,
Counsel for Defendant-Appellee.

5113

Plaintiffs' Assignment of Errors (Equity No. 50-175).

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, against GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity No. 50-175.

5114

Now come the plaintiffs in the above entitled case and present with their accompanying petition for appeal from the decree made and entered herein on October 27, 1936, the following assignment of errors:

5115

1. The Court erred in holding claims Nos. 1 and 4 of Arnold Letters Patent No. 1,520,994 invalid and void and in dismissing the bill of complaint as to the said Letters Patent.

2. The Court erred in not holding claims Nos. 1 and 4 of Arnold Patent No. 1,520,994 valid and infringed by the defendant.

3. The Court erred in not ordering an injunction and an accounting with respect to claims

5116 *Plaintiffs' Statement as to Appeal Bond and Citation.*

Nos. 1 and 4 of Arnold Letters Patent No. 1,520,994.

4. The Court erred in finding that claims Nos. 1 and 4 of Arnold Letters Patent No. 1,520,994 merely involved the selection of a well known means to accomplish a necessary purpose which falls short of indicating the exercise of the inventive faculty.

5117

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

By HENRY R. ASHTON,
Counsel for Plaintiffs-Appellants.

Dated: November 16, 1936.

Service hereof acknowledged this 16 day of November, 1936.

5118

SAMUEL E. DARBY,
Counsel for Defendant-Appellee.

Plaintiffs' Statement as to Appeal Bond and Citation.

Plaintiff submitted an appeal bond in the sum of $250. which was approved and filed, and a citation in suit No. 50-175 was issued on November 17, 1936, and served on November 20, 1936.

5119

Stipulated Praecipe.

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs, vs. GENERAL TALKING PICTURES CORPORATION, Defendant.	In Equity Nos. 50-175, 50-177, 50-178.

5120

IT IS HEREBY STIPULATED AND AGREED, by and between counsel for the respective parties hereto, that the printed record to be transmitted to the Court of Appeals for the Second Circuit, pursuant to the appeals heretofore taken in these cases, shall contain the following:

5121

1. Bill of Complaint in No. 175.
2. Amendment to Bill of Complaint in No. 175.
3. Answer in No. 175.
4. Defendant's Bill of Particulars in No. 175.
5. Stipulation and Order Amending Answer in No. 175.
6. Decree in No. 175.
7. Bill of Complaint in No. 177.
8. Amendment to Bill of Complaint in No. 177.

9. Answer in No. 177.
10. Defendant's Bill of Particulars in No. 177.
11. Stipulation and Order Amending Answer in No. 177.
12. Decree in No. 177.
13. Bill of Complaint in No. 178.
14. Amendment to Bill of Complaint in No. 178.
15. Answer in No. 178.
16. Defendant's Bill of Particulars in No. 178.

5123

17. Stipulation and Order Amending Answer in No. 178.
18. Decree in No. 178.
19. The Opinion, dated Sept. 16, 1936.
20. Stipulation and Order in the three suits that opinion be deemed sufficient findings of fact and conclusions of law.
21. Supersedeas Order in the three suits.
22. Defendant's Petition for Appeal in the three suits.
23. Order Allowing Defendant's Appeals in the three suits.

5124

24. Defendant's Assignment of Errors in the three suits.
25. Statement as follows: "Defendant submitted a supersedeas bond in the sum of $10,000."
26. Statement as follows: "Defendant submitted an Appeal Bond in the sum of $250. which was approved and filed, and a citation in the three suits was issued on Nov. 13, 1936, and served on November 16, 1936."
27. Plaintiffs' Petition and Order Allowing Appeal in No. 175.

28. Plaintiffs' Assignment of Errors in No. 175.
29. Statement: "Plaintiff submitted an appeal bond in the sum of $250. which was approved and filed, and a citation in suit No. 175 was issued on November 17, 1936, and served on November 20, 1936."
30. Statement of the testimony.
31. Exhibits to be reproduced:
Plaintiffs' Exhibits: 1 A to 1 H, 2 to 10, 13 to 15, 17, 19, 20, 24 to 26, 31 to 37, 39 5126
to 66, 73 to 78. (Omit 57 and 58 and 1D.)
Defendant's Exhibits: A to N.
32. The following Exhibits are to be transmitted to the Court of Appeals as Physical Exhibits:
Plaintiffs' Exhibits 11, 12, 16, 18, 21, 22, 23, 27, 28, 30, 38, 67 to 72, 57 and 58.
32A. List of references cited in Patent Office during prosecution of Lowenstein and Mathes patents.
33. This stipulated praecipe.
34. Stipulation and Order approving the statement of evidence. 5127
35. Clerk's Certificate.

(Sgd.) SAMUEL E. DARBY, JR.,
Counsel for Defendant.

(Sgd.) HENRY R. ASHTON,
Counsel for Plaintiffs.

Dated: February , 1937.

5128

Stipulation.

UNITED STATES DISTRICT COURT,

SOUTHERN DISTRICT OF NEW YORK.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Plaintiffs-Appellants, vs. GENERAL TALKING PICTURES CORPORATION, Defendant-Appellant.	In Equity Nos. 50-175, 50-177, 50-178.

5129

IT IS HEREBY STIPULATED AND AGREED that the foregoing in three volumes is a true transcript of the record in the above entitled cases, as agreed upon by the parties.

5130

Dated: April , 1937.

HENRY R. ASHTON,
Counsel for Plaintiffs.

DARBY & DARBY,
Counsel for Defendant.

5131

Clerk's Certificate.

UNITED STATES OF AMERICA, }
Southern District of New York, } ss.:

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Plaintiffs-Appellants,

vs.

GENERAL TALKING PICTURES CORPORATION,
Defendant-Appellant.

In Equity Nos. 50-175, 50-177, 50-178.

5132

I, CHARLES WEISER, Clerk of the District Court of the United States for the Southern District of New York, do hereby certify that the foregoing in three volumes is a correct transcript of the record of the said District Court in the above-entitled cases, as agreed upon by the parties.

5133

IN TESTIMONY WHEREOF, I have caused the seal of the said Court to be hereunto affixed, at the City of New York, in the Southern District of New York, this day of April, 1937.

CHARLES WEISER,
Clerk.

(Seal)

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PAGE

[fol. 1712] UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT

WESTERN ELECTRIC COMPANY, INCORPORATED; ELECTRICAL RESEARCH PRODUCTS, INC., and American Telephone and Telegraph Company, Plaintiffs-Appellees, Appellants,

against

GENERAL TALKING PICTURES CORPORATION, Defendant-Appellant, Appellee.

Before Manton, Swan and A. N. Hand, Circuit Judges

Appeal from the District Court for the Southern District of New York. Suit for infringement of seven patents. Decree for plaintiffs on six patents and for the defendant on one. Both parties appeal. Decree affirmed.

Darby & Darby, Zeiger & Berliner, Solicitors for Defendant; Samuel E. Darby, Jr., Ephraim Berliner, of Counsel.

Merrell E. Clark, Henry R. Ashton, Counsel for Plaintiff; Charles Neave, F. T. Woodward, H. A. Pattison, E. J. Driscoll, of Counsel.

MANTON, Circuit Judge:

Three suits for patent infringement were tried together and will be considered in one opinion. (Western Electric Co. v. General Talking Pictures, 16 Fed. Supp. 293.) They involve the validity of decrees holding valid and infringed the Lowenstein Patent No. 1,231,764 (Claims 1, 2, 4, 5, 6, 7) for a Negative Grid Bias, filed April 24, 1912; Mathes patent No. 1,426,754 for a Grid Biasing Resistance, filed October 23, [fol. 1713] 1916 (Claim 8); Arnold patent No. 1,329,283 (Claims 7, 10, 13) for a Power Circuit, application filed May 28, 1914; Arnold Patent No. 1,403,475 (Claims 8, 9, 10), for Resistance Capacity Coupling, application filed September 3, 1915; Arnold patent No. 1,448,550 (Claims 1, 12), for Definite Input Impedance, original applications filed September 3, 1915 and November 2, 1915; Arnold patent No. 1,465,332 (claims 1, 3, 5, 8, 10, 11) for Common Plate Supply, original application filed September 3, 1915. The Arnold patent No. 1,520,994 (Claims 1 and 4), for Gain Control, original application filed September 3, 1915, was held invalid.

These patents relate to the vacuum tube amplifier. Infringement is not seriously disputed if the patents are valid. The defendant, in addition to the general claim of invalidity of each patent, defends upon the ground that the five Arnold patents are invalid because of public use by one of the plaintiffs, American Telephone & Telegraph Company, for more than two years before the particular applications, upon which the patents were issued, were filed. None of the five patents was in public use more than two years before the original applications were filed and the inventions of but three of them (Nos. 1,329,283; 1,448,550 and 1,520,994) were in such public use more than two years before the particular applications on which they were issued were filed. Such applications in each instance were copending with the original applications. Another defense is made, based on the claim that because these amplifiers were purchased from the American Transformer Co., a licensee under the patents, although their sales were for private (amateur and experimental) use, infringement is avoided. The sales, however, [fol. 1714] to defendant were specifically for public or business use, that is, reproducing talking motion pictures in theatres for profit. Defendant leased the amplifiers it purchased to theatre owners and operators.

A defense is made that there was an acquiescence by plaintiffs in the infringement which amounts to an estoppel.

The patents relate to combinations of three electrode vacuum tubes, and circuits and circuit elements useful for amplification. Each of the ordinary sounds of speech and music is composed of many different frequencies which must be accurately reproduced. The problem of amplification was to reproduce without distortion the input of the amplifier in its output greatly increased in energy. The patents in suit deal with one or more of the problems of this art of amplification which the patentee solved while the art was still young. The latest of the inventions was made in 1916 before amplification was commercially applied to such uses as radio broadcast transmission and reception, public address systems and talking motion pictures. All inventions, except that of Lowenstein, were made by the inventors employed by the Western Electric Company.

There can be no earnest denial of the usefulness and commercial success of the inventions which were held valid below.

Lowenstein Patent

The Negative Grid Bias patent of Lowenstein solved the problem of distortion in the input circuit of the three-electrode tube, which was due to the flow of current in that circuit. He eliminated distortion producing current by providing means for biasing the grid negatively. We held this [fol. 1715] patent valid and infringed in Western Electric Co. v. Wallerstein, 60 Fed. 2, 723. The same claims 1, 2, 4, 5, 6 and 7 were there involved. The defendant admits that the prior art now relied upon was considered by us in the earlier decision. The arguments against the validity of the Lowenstein patent now appearing were considered there and nothing is added here which warrants our overruling the decision there. We there considered the patents to Von Lieben (No. 1,038,910), Stone (No. 884,110), and DeForest (Nos. 841,347; 879,532; 995,126) and found that they did not anticipate this patent, and we concluded that Lowenstein made a contribution to the art of great merit and this patent was held valid and infringed. Its claims are infringed here.

Mathes Patent

The Grid Biasing Resistance Patent to Mathes provided an improved means of obtaining the negative grid potential of the Lowenstein patent, which improved means had the advantage of eliminating the extra battery (c) employed by Lowenstein. He accomplished this by making the filament heating or "a" battery serve, in combination with a resistance placed in the filament heating circuit, the additional function of biasing the grid. Claim 8 defines the specific and useful series circuit combination of grid biasing resistance, filament heating battery and filament, the grid biasing resistance being included in the same circuit as the filament and filament heating battery.

As prior art the defendant refers to Arnold Patents No. 1,129,942 and No. 1,129,943 and Colpitts Patent No. 1,388,450. The Arnold patents do not disclose a grid biasing resistance in the filament heating circuit, as claimed in Mathes' [fol. 1716] Claim 8, but employ a separate battery, as Lowenstein did, for providing the desired negative grid potential. But defendant argues that in the Arnold patents the filaments of the three tubes shown are all connected together in series so that all can be heated by the "a" battery, and

says that the resistance (14) corresponds to Mathes' resistance. But that resistance is not in the filament heating circuit of the tube as Mathes' claim 8 provides. The purpose for which the resistance (14) is used in the Arnold patent is solely to act as a coupling between the output circuit of the first tube and the input circuit of the second tube. The effect on the grid of the second tube of the drop in potential across the resistance (14) is wholly erased by the positive potential of the plate battery (13) which is poled positively to the grid of the second tube. The grid of the second tube is not biased negatively by this resistance but is so biased by Lowenstein's battery (11), poled negatively to the grid and included in the circuit for the same purpose as in Lowenstein's patent. The testimony shows that if the Lowenstein battery (11) was not included in the circuit to buck out the effective positive voltage from the plate battery (13), the grid of the tube would be highly positive notwithstanding the presence of the resistance (14). The grid would be at the same high and positive potential as the plate of the preceding tube, to which it would be directly connected were it not for Lowenstein's battery (11). Instead of teaching that Lowenstein's battery can be dispensed with, these Arnold patents teach that it should be used and they do not teach, as Mathes provides, that the filament heating battery can serve the additional function of biasing the [fol. 1717] grid if the biasing resistance is included in the series in the filament heating circuit.

Colpitts discloses a resistance not in the filament heating circuit. The resistance (64) tends to compensate out or eliminate the signal which it is the whole purpose of the amplifier to strengthen. This resistance has a deamplifying effect which makes it objectionable in an amplifier. Defendant has been unable to establish priority of invention. Mathes made a distanct contribution to the art in the particular series arrangement of grid biasing resistance, filament and filament heating source; the invention is held valid.

Arnold Patent No. 1,329,283

This is the Power Circuit Patent issued in 1920 upon an application filed July 30, 1918, which was a continuation of two earlier applications filed May 28, 1914. Arnold discloses in this patent the fundamentals of the tube's operations and how to construct it so as definitely to adapt it to

utilization in circuits and with other circuit elements to give efficient results. He teaches how to produce tubes having the desired characteristics, and how to determine in what circuit arrangement the particular types of tubes should be used to do the work. The invention relates to thermionic amplifiers of the audion type and its object is to provide a structure by which the certain desired characteristic of the amplifier may be secured at will and in an efficient manner. The principles of operation are referred to and four suggestions as to construction are made. They are, (a) to locate the grid as near as possible to the filament for all purposes; (b) space the plate widely from the filament for high voltage output and closely for high current output; (c) use a [fol. 1718] fine mesh grid for high voltage output and a coarse mesh grid for high current output, and (d) for maximum efficiency, to construct the tube so that its internal impedance between the plate and the filament is "equal to the total impedance of the variable current consumption circuit." Thus the internal impedance between the plate and filament of the tubes should equal or match the impedance of the external circuit, including the receiving or translating device to which power is to be supplied. In producing an amplifier with a high current or a large power output, these principles are applied. Such were the defendant's amplifiers. Greater power is required to drive the loud speakers for public address, or motion picture systems than is required for radio or telephone. Without the power amplifier disclosed in this patent, it is said that public address, and talking motion picture systems could not be successfully operated with any loud speaker yet devised.

The claims in suit—Nos. 7, 10 and 13—are each for a novel combination of a power or high current three-electrode vacuum tube of low impedance with a work circuit having low impedance of the same order of magnitude. Claim 7 specifies that the three elements of the tube are so spaced that the impedance of the discharge device (tube) between said anode (plate) and cathode (filament) is of the same order as that of the outgoing (work) circuit. Claim 10 is more specific, stating the filament is placed in immediate proximity to the grid, and that the plate is so spaced from the filament and the grid made of such coarse mesh that the two impedances mentioned above are of the same order. Claim 13 is similar to Claim 7, adding however, "a source of variable electro-motive force in said input circuit."

[fol. 1719] The prior art referred to, the Seibt patent, No. 1,012,456, was not dealing with a vacuum tube which was unknown when Seibt filed his application in 1907. He shows an arc transmitter with a microphone and taught that in such a system a maximum output may be obtained when the resistance of the microphone is equal to the resistance of the rest of the system. This patent has no bearing upon this invention. The other patents referred to, Colpitts No. 1,129,959, and Langmuir No. 1,558,436, do not anticipate.

Defendant relies on Arnold patent No. 1,129,943 and claims that what Arnold disclosed in that patent and did not claim, he abandoned, and cannot reclaim what he has abandoned by his application filed more than three years subsequent to the issuance of the earlier patent. This is contrary to our ruling in Tenitel Marble Co. v. Hungerford, 22 Fed. 2, 259. The application for the Arnold patent No. 1,129,943 was filed May 28, 1914, the same day on which the original applications upon which the patent now considered was based.

Each of the three Arnold applications disclosed the invention of the patent in suit and the application on which it issued was copending with the original applications. This Power Circuit Patent has become an important contribution to the art here involved. It has become a device of very practical usefulness. It has organized elements and adapted their relations to the circuit described and constitutes an invention.

[fol. 1720] Arnold Patent No. 1,403,475

This Resistance Capacity Coupling Patent issued January 17, 1922, on an application filed November 11, 1920, is a division of and was copending with Arnold's original Serial No. 48,873, filed September 3, 1915. The invention was employed in the receivers used in radio telephone experiments in 1915. It disclosed a new method of coupling the output circuit of one three-electrode vacuum tube to the input circuit of another, by which what is known as frequency distortion is avoided. This new coupling made it possible for the first tube to pass on to the next all frequencies of the signals equally amplified, without distorting any of them. Another advantage of the coupling is that extremely small as well as large currents or energies are equally effectively passed to the next tube. This is of advantage for talking

motion pictures. In such amplifiers only a very small energy is produced by the photo-electric cell when light, modulated only by variations of density of the talking motion picture films, falls upon the cell. The direct current path of the plate or output circuit of the first tube consists of the space between the plate and the filament, the battery, the choke coil and the resistance which is the coupling resistance. The voltage variation at the top of this resistance corresponds exactly to the signal no matter what the frequency. The grid of the second tube is connected to its filament through the biasing battery and the resistance (29), the function of the latter being to permit the electrons, which would otherwise accumulate on the grid of the second tube and block the operation, to leak off through the resistance. Claims 8, 9 and 10 each specify the resistance and condenser of the [fol. 1721] patent, and claim 10 includes additionally the resistance (29).

The Arnold patent No. 1,129,942 of the prior art does not disclose a resistance capacity coupling amplifier. Defendant claims in fig. 6 the coupling between the first and second tube is a resistance capacity coupling, but it is not. It is an inductance capacity coupling as the defendant's expert admitted, referring to the difference as an essential one. An inductance consisting of a wire-wound iron core, impedes the flow of alternating current, impeding high frequencies more than low, and causing distortion. The object of the patent in suit was to avoid such discrimination. We think this patent valid.

Arnold Patent No. 1,448,550

This Definite Input Impedance Patent issued March 13, 1923, upon an application filed February 3, 1919, was the continuation of two earlier applications filed September 3, 1915, and November 2, 1915. The input circuit of a three-electrode vacuum tube has a very high impedance. When the negative grid bias invention is used, the impedance of the input circuit becomes substantially infinite because no electrons can flow from the filament to an electrode which is negative. A tube to be useful, as from the end of a telephone line or the output side of another vacuum tube, needs connections to its input circuit so as to supply the tube with the signals to be amplified. In the absence of this invention, the action which would occur in imposing the signals on the

input circuit would cause a rebound. The reflection back into the line or into the preceding tube, due to the high [fol. 1722] impedance encountered may produce an echo in the telephone line which the speaker at the far end of the line will hear as an interfering echo of his own voice. And it may disturb the operation of other amplifiers in the line and might result in producing a state of resonance in the transformer at the end of the line upsetting its operation so that it will discriminate as to certain frequencies and may result in a feed back by setting up undesired oscillations which will be fed back into the line or preceding tube and interfere with their operations. These defects were cured by this invention now considered.

Claim 12 differs from Claim 1 only in that it specifies that the impedance is of the order of 500,000 ohms as in defendant's amplifier. Other engineers were engaged in finding a solution of the problem, particularly those associated in the Western Electric Company and failed until Arnold made this invention.

We think this patent is valid and withstands the attack of double patenting claimed. Defendant asserts double patenting by this patent and the subject matter of the Arnold Power Circuit Patent in suit. The claim of invention of the patent in suit is a high impedance connected across the secondary of the input transformer of a three-electrode vacuum tube amplifier. Such invention is not found in any of the claims of the Arnold Power Circuit. For double patenting it must appear that the claims are the same. Traitel Marble Co. v. Hungerford, 22 Fed. 2, 259,262.

Arnold Patent No. 1,465,332

This patent is for a Common Plate Supply. It issued on a divisional application filed August 28, 1920, which was [fol. 1723] based on an application filed September 3, 1915. This invention made it possible for the first time to use a common source of plate current for two or more three-electrode vacuum tube amplifiers without introducing prohibitive distortion. The problem was in using the common source to prevent that source and the connections to it from serving as a path through which the amplified signals in the plate circuit of the subsequent tube or tubes could get back into the circuits of the preceding tube or tubes thereby setting the circuits into a state of oscillation or regenera-

tion. When such feed back occurs, the amplified signals in such tube will flow into the plate circuit of the preceding tube and through that circuit will again be impressed on the input circuit of the tube from which they came; the cycle thus set up will change the tube into a generator of oscillations nullifying the usefulness of an amplifier.

This invention made it possible to use a common plate or direct current supply for a plurality of tubes while preserving the alternating or signal current separateness of the output circuits of the tubes.

Prior to this invention whenever a plurality of vacuum tube amplifiers were used, it was necessary to employ separate sources of plate current for each of the tubes in order to prevent the introduction of prohibitive distortions. By this invention it became possible for the first time to use a common plate supply for all the tubes without distorting the output of the amplifier system.

Arnold patent No. 1,129,942 is referred to as an anticipation. This earlier patent shows a battery for supplying plate current to a plurality of tubes, but it does not disclose [fol. 1724] the arrangement of series inductances and shunt condensers as shown in this patent and which are essential to the best results with a common source of plate current in an amplifier. Without these filter means prohibitive distortion is introduced through the path common to the tubes. Claims in suit 1, 3, 5, 8, 10 and 11 are all infringed.

Arnold Patent No. 1,520,994

This is the Gain Control Patent applied for March 28, 1919, and issued Wecember, 1924; the original application was filed September 3, 1915. The claim for this patent is that it was impossible to control the gain, that is the amount or degree of amplification of a three-electrode vacuum tube amplifier without seriously upsetting the operations of the entire system. This patent is for a variable resistance in the place where the resistance involved in the definite input impedance patent was placed. The purpose of the invention was to effect an easy means of regulating the amount of amplification to be obtained by regulating the length of the resistance, which would be in the grid circuit. The court below properly found that this was applying a potentiometer to the resistance to reach a result which such an instrument would be expected to produce. With knowledge

of the well known use of a potentiometer, it did not require invention to make use of this device. It is therefore unnecessary to consider the patents of the prior art referred to. This patent is held to be invalid for want of invention.

But it is contended by the defendant that the five Arnold patents are invalid because of public use made by the plain-
[fol. 1725] tiff, the American Telephone & Telegraph Co., the patentee or patent owner, more than two years before the particular applications on which these patents issued were filed. There is no proof of public use of the inventions, The Resistance Capacity Coupling Patent or the Common Plate Supply Patent, prior to the filing dates of the applications on which these patents issued. These patents may be excluded from this defense. The other three Arnold patents, Power Circuit Patent, Definite Impedance Patent, and Gain Control Patent, were used in the transcontinental line of the Telephone Company which was opened to the public in January, 1915, the first two issued on continuing applications and the third on a divisional application. There was continuity of prosecution between the original applications and the continuing and divisional applications, and the original applications in each instance fully disclose the invention. In the instance of the Power Circuit Patent, the original application was filed more than a year before the public use relied upon, and the original applications for the other two patents were filed less than a year after the public use.

Defendant's contention seems to be that no patent is valid unless the application on which it issued was filed less than two years subsequent to any public use. It refers us to Westinghouse Elec. & Mfg. Co. v. Jeffrey-DeWitt Insulator Co., 22 Fed. 2, 277 (C. C. A. 2); Crown Cork & Seal Co. v. Ferdinand Gutmann Co., 86 Fed. 2, 698; Webster Elec. Co. v. Splitdorf Elec. Co., 264 U. S. 463, and Chapman v. Wintroath, 252 U. S. 126.

In the Westinghouse case, the patent in suit had issued under a divisional application which was filed more than two years after the defendant had itself commenced the
[fol. 1726] sale of the infringing device, whereas here the public use relied upon is that of the patentee or patent owner. It was not an adverse public use or one which was antagonistic to the patentee. The divisional application is normally entitled to the benefit of the original filing date and it is

difficult to see how public use under license from an applicant can amount to laches under which adverse rights may arise. Wirebounds Patent Co. v. Saranac Machine Corp., 37 Fed. 2, 830,841. The Westinghouse, Webster Electric Co. and Chapman cases (supra) involve intervening adverse rights either of the defendant or some third party. In the instant case there is no pretense whatever of any claim to intervening rights, either of defendants' own or of anyone else. The patentee's public use of his own invention after filing his original application does not invalidate the patent issued upon a division made more than two years after such public use.

In the Crown Cork & Seal Co. case (supra), an adverse patent for the same invention had issued to a third party before the divisional application for the patent in suit was applied for. There also the patentee had not only deliberately cancelled the disclosure of the invention from the specifications of his original application, but had also cancelled the claims which were sufficiently broad to cover the invention. The patentee had really abandoned the invention, and we said, "might never have considered the subject worth claiming as an invention" had a patent for the invention not issued to another.

But the defendant claims that the subject matter of the claims in suit of the Arnold patents was not claimed in the original applications. It is true that the particular combina- [fol. 1727] tions of the claims in suit were not specifically claimed but broader combinations were claimed. And in the Crown Cork & Seal Co. case, we said:

"A patentee is not to be held at fault for failure to have divided his claims at an earlier date, merely because he might have, when instead he had elected to prosecute the broader claims of his original application."

We also pointed out a distinction to be made between this case and the Crown Cork & Seal Co. case by saying,

"But in the case at bar for a period of more than two years Warth apparently did not wish to claim the preheating method, having deliberately cancelled the pre-heating specification from his original application and shaped his claims so as to exclude it and his patent having been granted January 6, 1931."

This defense we deem no bar to the Arnold patents.

A separate defense is interposed by defendant contending that the amplifiers charged with infringement were licensed because they were purchased from a licensee. February 1, 1927, the Transformer Company obtained from the Radio Corporation, with the assent of the patentee, a license to manufacture and sell patented amplifiers for private, that is, amateur and experimental, uses only. The defendant purchased these amplifiers from the Transformer Company with knowledge of the restriction but used the patented device commercially. The question presented is whether the restriction is binding upon the appellant as a purchaser from the licensee.

A patentee who, under the patent laws, is granted an exclusive monopoly of use, should be able to reserve and preserve his monopoly over the commercial use of his patented [fol. 1728] invention; in other words, he may altogether exclude others from the commercial field. It is not disputed that under the patent law the patentee may impose binding restrictions upon the licensee which would include the restriction in issue. But it is maintained that upon the sale of the patented article restrictions of any kind are no longer enforcible by authority of the patent laws and that the patentee must seek protection, if any, under ordinary rules of contract. Motion Pictures Co. v. Universal Film Co. (243 U. S. 502) in overruling Henry v. A. B. Dick Co. (224 U. S. 1) held ineffective a restriction on the use of a patented invention to materials not covered by the patent itself. The Carbice Corp. v. American Patents Corp. (283 U. S. 27) reaffirmed this rule stating that the patentee cannot, by such a restriction, monopolize commerce in unpatented materials. The court compared the problem before it with that of restrictions upon resale price which had been nullified in Bauer v. O'Donnell (229 U. S. 1) and in subsequent cases (Straus v. Victor Machine Co., 243 U. S. 490; Boston Store v. Graphone Co., 246 U. S. 8) and termed such restrictions "limitations beyond the legitimate scope of its [the patentee's] monopoly." The holdings of these cases are not necessarily controlling on the point here at issue and could rest on the valid distinction that even under the patent law the monopoly of use, though granted by the statute in unqualified terms, is subject to limitations as to the kind of restrictions which may lawfully be imposed. A policy preventing control of resale prices and an extension of monop-

oly to unpatented materials would have nothing to do with the patentee's expressed desire, known to the purchaser, to [fol. 1729] keep the commercial field within its exclusive dominion.

The Supreme Court has stated obiter that the sale of the patented invention puts it beyond the confines of the patent law (Boston Store case, 246 U. S. 8) where a resale price restriction was held invalid as against a purchaser and again in United States v. General Electric Co. (272 U. S. 476) where such a restriction was upheld against licensee. In the Boston Store case, supra, it was stated that "price-fixing contracts are contrary to general law, void, and not within the remedies of the patent law." Such language suggests that the real reason underlying its holdings, and a restrictive explanation of the doctrine it enunciated so broadly, is, that there is a policy forbidding the remote control of resale prices. Mitchell v. Hawley (83 U. S. 544) which upheld a restriction of use to the original terms of the patent, can be supported. In that case there is a holding that such a restriction is valid against purchasers. In Bloomer v. McQuewan (14 How. 539) referred to by the defendant, the court stated there were no restrictions or conditions imposed and hence the purchasers were in no way limited.

This circuit recognized that the patentee may extend his monopoly beyond a sale by a licensee. General Electric Co. v. Continental Lamp Wks., 280 Fed. 846; Radio Corp. v. Andrea, decided June 7, 1937 (C. C. A. 2). It was beyond the scope of the American Transformer Company's license to sell the amplifiers for the use for which it sold them to defendants. The sale was therefore an infringement and not a licensee's lawful sale.

Another separate defense is interposed because of al- [fol. 1730] leged acquiescence by the plaintiffs in the infringement charged which is said to create an estoppel. Alleged conferences with the plaintiffs' officials, which they deny, are urged upon this question of acquiescence and ratification. The trial judge found against the claim that these conversations resulted in acquiescence or approval of the defendant's infringement.

Royalties were received and it is shown that the Radio Corporation of America refunded the royalties collected with respect to infringing amplifiers within two years after

they received a list showing who were the purchasers from the Transformer Company, and all the defendant's strictures against plaintiffs for receiving royalties for over a year after the suit was filed constitutes neither acquiescence nor ratification. The evidence shows lack of knowledge when royalties were received and it is difficult to see how later royalties can act as either acquiescence or estoppel since the very maintenance of the suit showed defendant that there was no acquiescence on which it could rely. If the royalties had not been returned perhaps it might have had some effect upon the plaintiffs' damages. All refunded royalties were accepted by the Transformer Company. But whether they were refunded or not is immaterial. See, Vulcan Mfg. Co. v. Maytag Co., 73 Fed. 2, 136. The first knowledge the plaintiffs had that the defendant was exceeding its license was in April 1929 and within five months it instituted this suit. This defense is without merit.

Decrees affirmed.

[fol. 1730½] [Endorsed:] United States Circuit Court of Appeals, Second Circuit. Western Electric Co. et al. v. General Talking Pictures. (Copy.) Opinion. Manton, Circuit Judge.

[fol. 1731] UNITED STATES CIRCUIT COURT OF APPEALS, SECOND CIRCUIT

At a stated term of the United States Circuit Court of Appeals, in and for the Second Circuit, held at the United States Court House, in the City of New York, on the 2nd day of August, one thousand nine hundred and thirty-seven.

Present: Hon. Martin T. Manton, Hon. Thomas W. Swan, Hon. Augustus N. Hand, Circuit Judges.

50/175

WESTERN ELECTRIC COMPANY et al., Plaintiffs-Appellants,

vs.

GENERAL TALKING PICTURES CORPORATION, Defendant-Appellant

Appeal from the District Court of the United States for the Southern District of New York

This cause came on to be heard on the transcript of record from the District Court of the United States for the Southern District of New York, and was argued by counsel.

On consideration whereof, it is now hereby ordered, adjudged, and decreed that the decree of said District Court be and it hereby is affirmed.

It is further ordered that a mandate issue to the said District Court in accordance with this decree.

Wm. Parkin, Clerk.

[fol. 1732] [Endorsed:] United States Circuit Court of Appeals, Second Circuit. Western Electric Company et al. vs. General Talking Pictures Corpn. (50/175.) Order for mandate. United States Circuit Court of Appeals, Second Circuit. Filed Aug. 2, 1937. William Parkin, Clerk.

[fol. 1733] UNITED STATES CIRCUIT COURT OF APPEALS, SECOND CIRCUIT

At a stated term of the United States Circuit Court of Appeals, in and for the Second Circuit, held at the United States Court House, in the City of New York, on the 2nd day of August, one thousand nine hundred and thirty-seven.

Present: Hon. Martin T. Manton, Hon. Thomas W. Swan, Hon. Augustus N. Hand, Circuit Judges.

50/177

WESTERN ELECTRIC COMPANY et al., Plaintiffs-Appellees,

vs.

GENERAL TALKING PICTURES CORPORATION, Defendant-Appellant

Appeal from the District Court of the United States for the Southern District of New York

This cause came on to be heard on the transcript of record from the District Court of the United States for the Southern District of New York, and was argued by counsel.

On consideration whereof, it is now hereby ordered, adjudged, and decreed that the decree of said District Court be and it hereby is affirmed with costs.

It is further ordered that a mandate issue to the said District Court in accordance with this decree.

Wm. Parkin, Clerk.

[fol. 1734] [Endorsed:] United States Circuit Court of Appeals, Second Circuit. Western Electric Company et al. vs. General Talking Pictures Corpn. 50/177. Order for Mandate. United States Circuit Court of Appeals, Second Circuit. Filed Aug. 2, 1937. William Parkin, Clerk.

[fol. 1735] UNITED STATES CIRCUIT COURT OF APPEALS, SECOND CIRCUIT

At a stated term of the United States Circuit Court of Appeals, in and for the Second Circuit, held at the United States Court House, in the City of New York, on the 2nd day of August, one thousand nine hundred and thirty-seven.

Present: Hon. Martin T. Manton, Hon. Thomas W. Swan, Hon. Augustus N. Hand, Circuit Judges.

50/178

WESTERN ELECTRIC COMPANY et al., Plaintiffs-Appellees,

vs.

GENERAL TALKING PICTURES CORPORATION, Defendant-Appellant

Appeal from the District Court of the United States for the Southern District of New York

This cause came on to be heard on the transcript of record from the District Court of the United States for the Southern District of New York, and was argued by counsel.

On consideration whereof, it is now hereby ordered, adjudged, and decreed that the decree of said District Court be and it hereby is affirmed with costs.

It is further ordered that a mandate issue to the said District Court in accordance with this decree.

Wm. Parkin, Clerk.

[fol. 1736] [Endorsed:] United States Circuit Court of Appeals, Second Circuit. Western Electric Company, et al. vs. General Talking Pictures Corpn. (50/178.) Order for Mandate. United States Circuit Court of Appeals, Second Circuit. Filed Aug. 2, 1937. William Parkin, Clerk.

[fol. 1737] UNITED STATES OF AMERICA,
Southern District of New York:

I, William Parkin, Clerk of the United States Circuit Court of Appeals for the Second Circuit, do hereby certify that the foregoing pages, numbered from 1 to 1736, inclusive in 3 volumes, contain a true and complete transcript of the record and proceedings had in said Court, in the case of Western Electric Company et al., Plaintiffs-Appellees, against General Talking Pictures Corporation, Defendant-Appellant, as the same remain of record and on file in my office.

In testimony whereof, I have caused the seal of the said Court to be hereunto affixed, at the City of New York, in the Southern District of New York, in the Second Circuit, this twelfth day of August, in the year of our Lord one thousand nine hundred and thirty-seven, and of the Independence of the said United States the one hundred and sixty-second.

Wm. Parkin, Clerk. By D. E. Roberts, Deputy Clerk.
(Seal United States Circuit Court of Appeals, Second Circuit.)

[fol. 1739] SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed October 11, 1937

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Second Circuit is granted, and the case is assigned for hearing immediately following No. 72.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.

Mr. Justice Roberts took no part in the consideration and decision of this application.

Mr. Justice Black took no part in the consideration and decision of this application.

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CHARLES ELMORE CROPLEY
CLERK

IN THE

Supreme Court of the United States

October Term, 1937

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,

Petitioner,

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, AND AMERICAN TELEPHONE AND TELEGRAPH COMPANY,

Respondents.

PETITION OF GENERAL TALKING PICTURES CORPORATION FOR A WRIT OF CERTIORARI TO THE CIRCUIT COURT OF APPEALS OF THE SECOND CIRCUIT AND BRIEF IN SUPPORT THEREOF.

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2. Can a patent owner, merely by a "license notice" attached to a device made under the patent, and sold in the ordinary channels of trade, place an enforceable restriction on the purchaser thereof as to the *use* to which the purchaser may put the device?	
3. Can an inventor who has filed an application for patent showing and describing, *but not claiming*, certain inventions, obtain a valid patent for such inventions by voluntarily filing a "divisional" or "continuation" application for said unclaimed inventions more than two years subsequent to public use of the said unclaimed inventions by him or his assignee or licensee?	
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IN THE

Supreme Court of the United States

October Term, 1937

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, AND AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

PETITION OF GENERAL TALKING PICTURES CORPORATION FOR A WRIT OF CERTIORARI TO THE CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT.

To the Honorable the Chief Justice and Associate Justices of the Supreme Court of the United States:

Your petitioner, General Talking Pictures Corporation, respectfully prays for a writ of certiorari to the Circuit Court of Appeals for the Second Circuit to review a judgment of that Court entered on July 26th, 1937. A transcript of the record in the case, including the proceedings in said Circuit Court of Appeals, is furnished herewith in accordance with the Rules of this Court.

Summary and Short Statement of the Matter Involved.

1. The present suit constitutes a consolidation of a number of separate suits brought by the respondents for alleged infringement of seven patents.

2. All seven of the patents in suit are included in the pool of patents contributed to by respondents and the other large companies of the electrical industry, including Radio Corporation of America, General Electric Company, Westinghouse Electric and Manufacturing Company, Wireless Specialty Apparatus Company, etc., which pool of patent rights has become popularly known as "The Radio Trust".

By the pooling arrangement, Radio Corporation of America was vested with the sole authority to grant licenses, under all of the patents of the pool, to manufacturers engaged in the manufacture and sale of apparatus embodying the inventions of the respective patents of the pool.

Under this authority Radio Corporation of America granted to a number of apparatus manufacturers licenses under all of the patents in the pool, specifically including the patents in suit,

> "to manufacture * * *, and to sell only for radio amateur reception, radio experimental reception, and radio broadcasting reception" (Vol. III, p. 1415).

One such manufacturer who acquired a license was known as American Transformer Company, which, under its license, manufactured and sold a piece of apparatus technically known as a vacuum tube amplifier (Vol. III, p. 1414).

3. Pursuant to the requirement of paragraph 5 of its license agreement (Vol. III, p. 1418), the American Trans-

former Company attached to each of its amplifiers a plate or label bearing the legend

> "*License Notice*—This apparatus is licensed only for radio amateur experimental and broadcasting reception under the following patents of the Radio Corporation of America and associated companies."*

4. Petitioner, over a considerable period of time, and in the ordinary course of its business, purchased many hundreds of the amplifiers from the American Transformer Company with this "License Notice" attached thereto, and proceeded to employ them in talking motion picture projection equipment, being engaged solely in the business of making and leasing talking motion picture equipment. The American Transformer Company received its price for the amplifiers, and paid its royalties to the Radio Corporation of America therefor under its license agreement with that company, reporting to the Radio Corporation of America the sales of the amplifiers made to petitioner. Petitioner was well known to Radio Corporation of America, as was the fact that its business was confined exclusively to the making and leasing of talking motion picture equipment.

5. Thereafter the present suit was instituted against petitioner by respondents charging infringement of the seven patents in suit under which the amplifiers were manufactured and sold under license by the American Transformer Company, because the *use* to which petitioner put the amplifiers was outside the alleged "licensed" use specified in the "License Notice" attached to the apparatus. In other words, although tribute to the patents had been paid by the licensee, the patent owner, by a "notice" attached

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* The patents in suit were included in the patents to which the "License Notice" applied.

to the apparatus, sought to retain control over the *use* to which the amplifiers bought in the usual channels of trade and paid for, was subsequently put by the purchaser thereof.

6. More than a year thereafter Radio Corporation of America returned to the American Transformer Company the royalties paid by the American Transformer Company on the amplifiers sold petitioner, although throughout that period it was aware not only of the sale of the amplifiers to petitioner, but also of the use to which petitioner put them (Vol. III, pp. 1568-1614).

7. With reference to the merits of the patents, five of the seven patents in suit issued to an inventor named Arnold. The application for each of the Arnold patents was filed more than two years subsequent to the widely publicized commercial use of the inventions thereof by American Telephone and Telegraph Company, in the first transcontinental telephone line between New York and San Francisco in January, 1915. The inventions of the Arnold patents have been used continuously in the transcontinental telephone line since that time (Vol. I, p. 102, fol. 305). Each of the Arnold patents purports to be either a "division" or a "continuation in part" of an application for patent filed by Arnold in September, 1915, but the divisional and "continuation" applications were not filed at the request of or required by the Patent Office, and the inventions defined by the claims thereof were at no time claimed in the parent applications. In other words, though the inventions of the Arnold patents were shown and described in an Arnold application filed within two years of January, 1915, *no claim was ever made for the inventions constituting the subject matter of the five patents in suit as issued until more than two years subsequent to the widely*

publicized commercial use of these inventions by the American Telephone and Telegraph Company.

Specifically, *Arnold Patent No. 1,329,289* issued on an application filed July 30, 1918—*three years and six months after respondent's commercial use* (Vol. II, p. 628).

Arnold Patent No. 1,403,475 issued on an application filed November 11, 1920—*five years and ten months subsequent to respondent's commercial use* (Vol. II, p. 637).

Arnold Patent No. 1,448,550 issued on an application filed February 3, 1919—*four years and one month subsequent to respondent's commercial use* (Vol. II, p. 641).

Arnold Patent No. 1,465,332 issued on an application filed August 28, 1920—*five years and seven months subsequent to respondent's commercial use* (Vol. II, p. 644).

Arnold Patent No. 1,520,994 issued on an application filed March 28, 1919—*four years and two months subsequent to respondent's commercial use* (Vol. II, p. 647).

It will thus be seen that by these series of applications, all filed more than two years, and several of them nearly six years subsequent to commercial use of the inventions disclosed thereby, respondents have succeeded in extending the patent monopoly for the inventions far beyond the seventeen years contemplated by the statute.

Questions Presented.

1. Can the owner of a patent, by means thereof, restrict the *use* made of a device manufactured under the patent, after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor?

2. Can a patent owner, merely by a "license notice" attached to a device made under the patent, and sold in the

ordinary channels of trade, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device?

3. Can an inventor who has filed an application for patent, showing and describing *but not claiming* certain inventions, obtain a valid patent for said inventions by voluntarily filing a "divisional" or "continuation" application for said unclaimed inventions more than two years subsequent to public use of the said unclaimed inventions by him or his assignee or licensee?

The Opinion of the Court of Appeals Below.

The Court of Appeals for the Second Circuit answered all three of the questions in the affirmative. With respect to the first and second questions, the Court of Appeals disregarded the numerous decisions of this Court on closely analogous questions* with the statement that the holdings of those cases are not necessarily controlling on the point here in issue (Vol. III, p. 1728). The pertinent statements of this Court in the *Boston Store Case* (246 U. S. 8) and in the *General Electric Case* (272 U. S. 476) were characterized as "obiter" (Vol. III, p. 1729); and the Court of Appeals concluded its opinion on this subject with the statement (Vol. III, p. 1729):

> "This Circuit recognized that the patentee may extend his monopoly beyond a sale by a licensee."

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* *Motion Pictures Patents Co.* v. *Universal*, 243 U. S. 502; *Bauer* v. *O'Donnell*, 229 U. S. 1; *Strauss* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Boston Store* v. *American*, 246 U. S. 8; *United States* v. *General Electric Co.*, 272 U. S. 476.

With respect to the third question above presented, the Court of Appeals predicated its affirmative decision upon a distinction between an inventor (and his assignee or licensee) and all other members of the public, holding that if a public use of the invention of the patent occurred by the defendant in the litigation or by any other member of the public more than two years prior to the application for the divisional application, the patent is invalid under Section 4886 R. S.; but, if such public use was by the inventor-applicant (or his assignee or licensee), the statute is inapplicable (Vol. III, p. 1726).

Reasons Relied Upon for the Grant of a Writ of Certiorari.

The discretionary power of this Court is invoked upon the following grounds:

1. The Circuit Court of Appeals for the Second Circuit has decided important questions of Federal Law in a manner which is believed to be untenable and in direct conflict with the applicable decisions of this Court.
2. The Circuit Court of Appeals for the Second Circuit has decided important questions of Federal Law in a manner which, unless corrected, will extend the monopoly of patent rights beyond the limits prescribed by the statute.
3. The Circuit Court of Appeals for the Second Circuit has decided important questions of Federal Law in a manner which makes it possible, under the Patent Statutes, to impose restrictions upon and control of the use of chattels acquired in fee simple by the purchasing public.

4. The Circuit Court of Appeals for the Second Circuit has decided, in a manner which is believed to be untenable, an important question of Federal Law which has not heretofore been specifically passed upon by this Court.

5. The Circuit Court of Appeals for the Second Circuit has decided important questions of Federal Law the effect of which is of great public importance and interest.

WHEREFORE your petitioner respectfully prays that a writ of certiorari be issued out of and under the seal of this Court directed to the United States Circuit Court of Appeals for the Second Judicial Circuit, sitting at New York, New York, commanding said Court to certify and send to this Court, on a day to be designated, a full transcript of the record and all proceedings of the Court of Appeals had in this case, to the end that this case may be reviewed and determined by this Court; that the judgment of the Court of Appeals for the Second Circuit be reversed, and that petitioner be granted such other and further relief as may seem proper.

SAMUEL E. DARBY, JR.,
Attorney for Petitioner.

EPHRAIM BERLINER,
Of Counsel.

Dated: New York, N. Y.
August 26th, 1937.

BRIEF IN SUPPORT OF PETITION FOR WRIT OF CERTIORARI.

The Opinions of the Court Below.

The opinion of the Circuit Court of Appeals for the Second Circuit is unreported, but is reproduced in the records filed herein (Vol. III, p. 1712 *et seq.*).

The opinion of the District Court is reported in 16 Fed. Supp. 293 (Rec. Vol. III, p. 1618).

Jurisdiction.

The grounds of jurisdiction are:

(1) The date of the judgment to be reviewed is July 26, 1937.

(2) The judgment was rendered in a suit in equity brought under the patent statutes to determine the issues of validity and infringement of Letters Patent of invention issued by virtue of Section 4886 R. S.

(3) The statute under which the jurisdiction is invoked is 240-A of the Judicial Code, 28 U. S. C. 347, as amended by the Act of February 13, 1925.

(4) Cases believed to sustain the jurisdiction are:

Motion Picture Patents Co. v. *Universal Film Co.*, 243 U. S. 502, 37 S. Ct. 416; 61 L. Ed. 871;
Carbice Corp. v. *American Patents Development Corp.*, 283 U. S. 27; 51 S. Ct. 344; 75 L. Ed. 819.

Statement.

The facts are sufficiently stated in the petition.

Statutes.

The section of the statute which is necessary to be considered in connection with the third question presented is R. S. 4886, reading as follows:

> "SEC. 4886. Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceeding had, obtain a patent therefor."

Specification of Errors.

The errors which petitioner will urge, if the writ of certiorari is allowed, are that the Circuit Court of Appeals for the Second Circuit erred:

(1) In holding, in effect, that the owner of a patent can, by means of the patent, restrict the use made of a device manufactured under a patent after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor.

(2) In holding, in effect, that a patent owner, merely by a "license notice" attached to a device made under the

patent and sold in the ordinary channels of trade, can place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device.

(3) In holding, in effect, that an inventor who has filed an application for patent showing and describing but not claiming certain inventions, can, more than two years subsequent to public use of the said unclaimed inventions by him or his assignee or licensee, file application for and obtain a valid patent for said inventions.

(4) In failing to hold that by the acceptance and retention, by plaintiffs-respondents' authorized agent, of the royalties paid by the licensed manufacturer of the alleged infringing devices, plaintiffs-respondents were barred, under the equitable principles of acquiescence and estoppel, from maintaining this suit.

(5) In failing to hold that each of the patents in suit is invalid as anticipated by or wanting of invention over prior patents in the art.

(6) In failing to reverse the decree of the District Court and to order the dismissal of the bill of complaint in the case.

Summary of Argument.

The points of the argument follow the questions presented, and are stated in the index hereto. For the sake of brevity they are omitted at this point.

ARGUMENT.

POINT I.

The owner of a patent cannot, by means of the patent, restrict the use made of a device manufactured under the patent after the device has passed into the hands of a puchaser in the ordinary channels of trade and full consideration paid therefor.

The Court of Appeals for the Second Circuit expressly held (Vol. III, p. 1729):

> "the patentee may extend his monopoly beyond a sale by a licensee."

Thus, its decision is to the effect that a patentee may, by means of the patent, maintain a control over the patented article after it has been sold to a purchaser and the full consideration paid therefor, and hold the purchaser as an infringer if the patented article is used in a manner other than that prescribed by a mere "notice" attached to the article when sold. If this decision is sound, the owner of a patent for an ordinary pocket cigarette lighter can attach a notice to the lighter (sold across the counter in any retail cigar store) to the effect that the lighter is licensed for use only for lighting cigarettes, and successfully maintain a suit for infringement against the purchaser of such a lighter if it is used for lighting cigars. The absurdity of the logical and practical consequences of the decision of the Court of Appeals in the case at bar will thus be seen.

The Court of Appeals apparently predicated its decision on the fact that this Court had not heretofore specifically passed upon an attempt to restrict the *use* of the

patented device after its sale, notwithstanding the fact that this Court, in a long line of decisions, has emphatically rejected every other attempted restriction for reasons equally as applicable to a restriction on *use*.

Every attempted restriction on a patented device after it had been sold, by means of the patent under which it was made, has heretofore been invalidated by this Court on the ground that a sale exhausts the monopoly of the patent owner as to the particular article involved. Thus, in *Bloomer* v. *McQuewan*, 14 How. 539, 55 U. S. 539, dealing with an attempted restriction on the *time of enjoyment*, this Court, speaking through Chief Justice TANEY, said:

> "* * * the purchaser of the implement or machine for the purpose of using it in the ordinary pursuits of life, stands on different ground. In using it, he exercises no rights created by the Act of Congress, nor does he derive title to it by virtue of the franchise or exclusive privilege granted to the patentee. * * * *And when the machine passes to the hands of the purchaser, it is no longer within the limits of the monopoly.*"*

Also, with respect to an attempted restriction on the *place of use*, this Court said in *Adams* v. *Burke*, 84 U. S. 453, 459:

> "But, in the essential nature of things, when the patentee or the person having his rights, sells a machine or instrument whose sole value is in its use, he receives the consideration for its use and he parts with the right to restrict that use. The article, in the language of the Court, passes without the limit of the monopoly."

(See also this Court's later decision in *Hobbie* v. *Jennison*, 149 U. S. 355, where an unsuccessful effort was made to limit the foregoing decision.)

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*Italics in this brief are ours.

Later, this Court, reviewing its decision in *Adams* v. *Burke* and *Hobbie* v. *Jennison*, said, in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659 at pages 666-667:

> "Upon the doctrine of these cases we think it follows that one who buys patented articles of manufacture from one authorized to sell them becomes possessed of an absolute property in such articles, unrestricted in time or place * * *.
>
> "The conclusion reached does not deprive a patentee of his just rights, because no article can be unfettered from the claim of his monopoly without paying its tribute. The inconvenience and annoyance to the public that an opposite conclusion would occasion are too obvious to require illustration."

To the same effect are the cases on attempted restrictions as to *resale prices*. Thus, in *Bauer* v. *O'Donnell*, 229 U. S. 1, 17, this Court said:

> "The right to vend, conferred by the patent law has been exercised, and the added restriction is beyond the protection and purpose of the act. This being so, the case is brought within that line of cases in which this court from the beginning has held that *a patentee who has parted with a patented machine by passing title to a purchaser has placed the article beyond the limits of the monopoly secured by the patent act.*"

Some years later this Court summarized its prior decision in *Bauer* v. *O'Donnell* in words strikingly apposite now, in the case of *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8, 23:

> "In other words, the decision was that *a patentee could not use and exhaust the right to sell, as to which a monopoly was given him by the patent law, and yet by conditions and stipulations continue that*

> *law in effect so as to make it govern things which, by his voluntary act were beyond its scope.* And * * * as a result, where an article has been sold and passed beyond the monopoly given by the patent law, remedies on the theory of infringement were not applicable to acts done which could not have that character * * *."

In the same case this Court continued (p. 25):

> "Reiterating the ruling in the two last cases (referring to *Bauer* v. *O'Donnell* and *Strauss* v. *Victor Talking Machine Co.*) it was again decided (in the *Motion Picture Patents* case) that, as by virtue of the patent law, *one who had sold a patented machine and received the price, and had thus placed the machine so sold beyond the confines of the patent law, could not by qualifying restrictions as to its use, keep under the patent monopoly a subject to which the monopoly no longer applied.*"

Finally, in the case of *United States* v. *General Electric Company*, 272 U. S. 476, this Court said at page 489:

> *"It is well settled, as already said, that where a patentee makes the patented article and sells it, he can exercise no future control over what the purchaser may wish to do with the article after his purchase. It has passed beyond the scope of the patentee's rights."*

The foregoing decisions of this Court show a consistency in ruling which is outstanding in the respect that it has not been departed from or modified, regardless of the guise in which attempted restrictions have been presented.

The fundamental reason underlying all of the decisions appears to be the simple fact that this Court recognized and gave full effect to the fact that when the patented article was sold and the price paid, the article was forever

outside of the monopoly of the patent, and became, like any ordinary chattel, owned in fee simple by the purchaser, to be used or done with as he saw fit, without hindrance by or under the control of the patent owner.

The Court of Appeals for the Second Circuit disposed of these authorities with the statement that the decisions were not controlling on the point here presented because a different *type* of restriction was being attempted. The direct and deliberately comprehensive statements of this Court in its decisions in the *Boston Store* and *General Electric* cases were swept aside by the Court of Appeals as mere *obiter*.

It is believed, that for the reasons which this Court so clearly set forth in all of its decisions above enumerated, the decision of the Court of Appeals below was in error, and this Court should grant a writ of certiorari and review this case to prevent the decision of the Court of Appeals from establishing a precedent in the Second Circuit so wholly inconsistent with the decisions of this Court in all of the foreging cases, and the sound fundamental principle upon which they were based.

POINT II.

A patent owner cannot, merely by a "License Notice" attached to a device made under the patent, and sold in the ordinary channels of trade, place an enforceable restriction upon the purchaser thereof as to the use to which the purchaser may put the device.

In *Strauss* v. *Victor Talking Machine Co.*, 243 U. S. 490, this Court was called upon to decide the legal effect of a "License Notice" affixed to a patented machine. The Victor Company manufactured phonographs and dis-

tributed them under license contracts, reserving title to the machine until expiration of its patent and compliance with conditions on a "License Notice". This license authorized dealers to convey a license to use the machine upon a minimum payment of $200. The defendant bought a quantity of the machines at less than the fixed price stated in the "License Notice". The Victor Company sought to enjoin this alleged infringement by preventing the defendant from selling them, presumably at lower prices.

This Court, in dismissing the bill for infringement, held the "Notice" invalid, and the full purport of its holding was later summarized in the following language in *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8, 24:

> "Basing its action upon the substance of things, and disregarding mere forms of expression as to license, etc., the Court held that the contract was obviously * * * not different from the one which had come under review in Bauer v. O'Donnell. Thus brushing away disguises resulting from forms of expression in the contract, and considering it in the light of the patent law, it was held that the attempt to regulate the future price or the future marketing of the patented article was not within the monopoly granted by the patent law * * *."

Again, in *Motion Picture Patents* v. *Universal Film*, 243 U. S. 502, this Court had presented to it two closely analogous questions—(1) whether a patentee who licenses the manufacture and sale of the patented device can, by a mere notice attached to the article, limit the purchaser to films which were not part of the patented machines, and, (2) whether the patentee, by a mere notice so attached, can reserve conditions to be fixed in the future.

Both questions were answered in the negative by this Court. It was held that nothing in the patent statutes provided for such notice and that "it can derive no aid from them" (p. 509). This Court thereupon proceeded to hold that the exclusive right to *use* is no greater than the exclusive right to vend, and that

> "* * * it is not competent for the owner of the patent by notice attached to its machine to, in effect, extend the scope of its patent monopoly by restricting the use of it to materials necessary in its operation" (p. 516).

Of course, there is no distinction in principle between attempting to restrict the materials to be used by an attached "License Notice", and attempting to restrict the use of the device itself. Both of the attempted restrictions consist of nothing more or less than attempts on the part of the patent owner to "extend the scope of its patent monopoly" in a manner neither contemplated nor permitted by the patent statutes.

The only distinction that exists between the decisions of this Court in the *Strauss* case and the *Motion Picture Patent* case, on the one hand, and the case at bar, is in the *character* of the restrictions sought to be effected by the "License Notice" attached to the goods sold. Because of the fact that the Court of Appeals differentiates the cases in this fashion when there is and should be no distinction between them, renders it necessary for this Court to clarify the situation by a decisive holding, as was apparently intended, that *no* valid restriction on the use of a patented article purchased from the patentee or his licensee, and the price paid therefor, can be effected by a mere "License Notice" attached to that article.

POINT III.

An inventor who has filed an application for patent showing and describing, but not claiming, certain inventions cannot obtain a valid patent for said inventions by voluntarily filing a "divisional" or "continuation" application for said unclaimed inventions more than two years subsequent to public use of the said unclaimed inventions by him or his assignee or licensee.

The present case presents a most glaring instance of an attempt to extend a patent monopoly many years beyond the seventeen years contemplated by the statute. Thus, the Arnold inventions were in public use in January, 1915. In September of 1915 application for patent was filed in which all of the inventions here involved were shown and described, but were not claimed. Then, at periods ranging from three years and six months to five years and ten months subsequent to the widely publicized commercial use of the inventions, *new* applications for patent were filed *for the first time claiming the unclaimed inventions disclosed in the original application*. These new applications were characterized as "divisional" or "continuation" cases *—but all of them were filed voluntarily by the patentee, and none of them at the request of or requirement by the Patent Office.*

Under Section 4886 of the revised statutes a valid patent may issue to an inventor only if the claimed invention—

> "was not in public use or on sale in this country for more than two years prior to his application".

We are not here concerned with whether or not the term "his application" refers to the parent application or the divisional application, because it obviously refers to his application for patent for the invention in question, and it never has been disputed by respondents that the first time claim was made for the inventions forming the subject matter of the patents in suit was when the alleged "divisional" or "continuation" applications were filed.

This Court, in *Webster Electric Co.* v. *Splitdorf*, 264 U. S. 463 stated (p. 472):

> "Our conclusion, therefore, is that, in cases involving laches, equitable estoppel, or intervening private or public rights, the two year time limit prima facie applies to divisional applications, and can only be avoided by proof of special circumstances justifying a longer delay."

The intervening public rights to the unclaimed Arnold inventions precluded the validity of the five Arnold patents in suit on "divisional" or "continuation" applications, each of which was filed more than two years subsequent to the original application on which they purported to be based, as well as more than two years subsequent to the public use of the inventions in the transcontinental telephone lines. *And it is to be noted that respondents in the present record offered no excuse or explanation for the lapse of the intervening years in filing the applications.*

Moreover, the Court of Appeals below noted two of its own decisions—that of *Western Electric & Manufacturing Co.* v. *Jeffrey DeWitt Insulator Co.*, 22 Fed. (2d) 277 and *Crown Cork & Seal Co.* v. *Ferdinand Guttmann*, 86 Fed. (2d) 698, both of which were predicated upon this Court's decisions in the *Webster* case, and in *Chapman* v. *Wintroath*, 252 U. S. 126.

In the *Jeffrey* case the Court of Appeals held that the defendant's manufacture and sale of the infringing device more than two years prior to the filing of the divisional application for the patent in suit (but subsequent to the filing of the application for the parent patent) constituted a statutory bar, under Section 4886, to the validity of the patent which issued on the divisional application. The Court said, in unequivocal language:

> "Since it has been clearly established that the sale was made two years prior to the filing of the divisional application, and no excuse given for such delay, the patent must be held to be invalid by reason of Section 4886 of the Revised Statute."

In the *Crown Cork & Seal* case the same Court held that a patent which issued on a divisional application was invalid because it was not filed until more than two years subsequent to the publication of the invention by a third party (in the form of a patent). This decision was again predicated on the provisions of Section 4886 of the Revised Statute.

Thus, though the Court of Appeals below has held that the provisions of Section 4886 of the Revised Statute constituted a statutory bar to the validity of a patent issued on a divisional application filed more than two years subsequent to the use and sale by a defendant, or publication by a third party, *it holds in the present case that the statute is not applicable to the patentee or his assignee or licensee.*

Of course, the statute draws no distinction whatever between the patentee or his assignee and any other member of the public, and no distinction in fact or in reason exists. Apparently, the Court of Appeals lost sight of the intervening public rights to which this Court referred in the *Webster* case, and petitioner, as a member of the public,

was entitled to exercise those rights without hindrance from respondents by means of the obviously invalid patents, the applications for which were deferred, without excuse or explanation, for from three to nearly six years subsequent to the widely publicized commercial use of the inventions claimed thereby.

We are not unmindful of the fact that the Court of Appeals in its opinion (Vol. III, p. 1727) implies, through the medium of a quotation of its decision in the *Crown Cork & Seal* case, that the *parent* or original Arnold application, throughout the intervening years between the public use of the inventions now patented and the divisional or continuational applications for patent therefor, contained "broader claims" the allowance of which was being solicited. Even if this fact were relevant (and we submit it is not), *there is no factual support for the inference and no assertion to that effect has ever been made, either in the record, the briefs, or in oral argument, by counsel for respondents.*

Obviously, the decision of the Court below establishes an erroneous precedent which should be speedily corrected by this Court by a review of this case.

POINT IV.

The questions here presented are of great public importance.

This Court judicially recognized the great importance to the public of any restrictions attaching to patented chattels acquired by purchase when it said, in invalidating the attempted restriction in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659 (at pp. 666, 667):

"The inconvenience and annoyance to the public that an opposite conclusion would occasion are too obvious to require illustration."

Moreover, it will be noted that this litigation is concerned with talking motion picture equipment. In consequence the same industry is involved as was involved in the *Motion Picture Patents* case, 243 U. S. 502, wherein this Court invalidated another attempted restriction on a patented device after its sale. There again judicial recognition was given not only to the public importance of such attempted restrictions, but the importance to the public of the industry involved as well, when it said (p. 519):

> "*A restriction which would give to the plaintiff such a potential power for evil over an industry which must be recognized as an important element in the amusement life of the nation,* under the conclusions we have stated in this opinion, *is plainly void,* because wholly without the scope and purpose of our patent laws, *and because, if sustained, it would be gravely injurious to that public interest, which we have seen is more a favorite of the law than is the promotion of private fortunes.*

In addition, it should be noted that these respondents have already been found to have established and maintained an illegal monopoly in the talking motion picture industry in violation of the anti-trust laws (see *Stanley Company of America Inc.* v. *American Telephone & Telegraph Company et al., General Talking Pictures Corp.* v. *Same, Duovac Radio Corporation* v. *Same,* preliminary injunction granted, 4 Fed. Supp. 80; on final hearing, 18 Fed. Supp. 650).

It is believed to be too clear to require further comment that the importance to the public of the questions here pre-

sented, as well as the importance to the public of the industry involved, are such as to alone warrant the allowance of a writ of certiorari in this case.

Likewise, it is, of course, of vital public importance to know whether or not public rights can be vitiated at the will of a patentee, as well as whether the statutory prerequisites to the validity of a patent under Section 4886 of the Revised Statutes apply to the patentee and his assignee or licensee as well as to the rest of the public.

Conclusion.

From the foregoing it appears that the Circuit Court of Appeals for the Second Circuit has rendered a decision which is in apparent conflict with controlling decisions of this Court, and which has seriously prejudiced the rights of petitioner.

Wherefore petitioner earnestly prays that the petition for writ of certiorari be granted, the cause reviewed, and the decree of the Court of Appeals reversed.

Respectfully submitted,

SAMUEL E. DARBY, JR.,
Attorney for Petitioner.

EPHRAIM BERLINER,
Of Counsel.

Dated: August 26th, 1937.

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Supreme Court, U. S.
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SEP 28 1937
CHARLES ELMORE CROPLEY
CLERK

IN THE

Supreme Court of the United States

October Term, 1937

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE & TELEGRAPH COMPANY,
Respondents.

REPLY BRIEF FOR PETITIONER IN SUPPORT OF PETITION FOR WRIT OF CERTIORARI.

SAMUEL E. DARBY, JR.,
Attorney for Petitioner.

EPHRAIM BENJAMIN,
Of Counsel.

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IN THE

Supreme Court of the United States

October Term, 1937

No. 357

GENERAL TALKING PICTURES CORPORATION,

Petitioner,

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE & TELEGRAPH COMPANY,

Respondents.

REPLY BRIEF FOR PETITIONER IN SUPPORT OF PETITION FOR WRIT OF CERTIORARI.

1. Respondents seek to avoid a review of this case by this Court by advancing the same contention that has been advanced by each of the patent owners in the cases decided by this Court and cited in the petition, where unsuccessful efforts were made by the patent owner to impose a restriction of some sort on a patented device after it had been sold, and consideration paid therefor. Thus, respondents make the assertion, that the sale of the patented device in the present case, by one licensed under the patents to manufacture and sell, was outside of the scope of the license, and therefore the manufacture as well as the sale constituted an infringement of the patent just as though a license had never existed. Exactly this situation existed, and the same contention was made, in each of the cases cited

by petitioner in support of its petition. For example, in the *Motion Picture Patents Case*, 243 U. S. 502 which is closely analogous to the present situation both as to subject matter and facts, the licensee under the patent *exceeded his license*, and it was because thereof that a suit for *infringement* ensued. There, as here, it was contended that the licensee, having *exceeded his license*, his act was not a *licensed* act, and he stood as an infringer.

In that case this Court said (p. 516):

> "* * * it is not competent for the owner of a patent by notice attached to its machine to, in effect, extend the scope of its patent monopoly by restricting the use of it to materials necessary in its operation * * *."

Similarly, in the cases involving a restriction on place of use, *e. g.*, *Adams* v. *Burke*, 84 U. S. 453, the licensee knowingly sold the patented device for use outside of the territory to which his license was restricted. There, again, it was contended by the patentee, as is here contended, that the sale was outside of the license, and that the licensee, therefore, stood in the shoes of an infringer just as though no license existed. In the later case of *Hobbie* v. *Jennison*, 149 U. S. 355, 363, this Court expressly held

> "that *neither the actual use of the pipes in Connecticut, or a knowledge on the part of the defendant that they were intended to be used there, can make him liable.*"

Similarly the same contentions were made on attempted restrictions as to resale price (*e. g.*, *Strauss* v. *Victor*, 243 U. S. 90) where the resale price was specified by the license, and sales made of the patented device at prices less than those specified. The sales were charged to constitute "in-

fringement" of the patent and the seller was charged to be an infringer as though no license ever existed.

Indeed, it is quite obvious that the question involving the legality of an attempted restriction on a patented article after it has been sold and the price paid therefor could not have arisen under the charge of infringement unless the defendant in each of those cases had, according to the patent owner's argument at least, stood in the shoes of an infringer who was not vested with the immunity from suit incident to a license.

Thus, on analysis, respondents predicate their hope of having this Court refuse a review of this case upon an argument which has been persistently made and consistently rejected by this Court.

Thus, every type of restriction heretofore considered by this Court attempted to be attached by the patent owner to the patented device after its sale, by means of the patent, has been invalidated because of the fact that when the patentee or his licensee has exercised the right to "vend", the patented device is no longer within the monopoly of the patent. And each such attempt has been characterized as an attempt to extend the patent monopoly in a manner unwarranted by the statute.

2. Respondents likewise assert (Brief, p. 5):

> "restrictions on the use of patented articles, imposed by the patentee, or by a licensee having an unrestricted right to sell the patented article, and brought to the knowledge of the vendee at the time of the sale, have been uniformly upheld by this and the lower Federal Courts."

With this we flatly disagree, as has this Court in all of the decisions cited in the petition. The decisions of this

Court cited by respondents in support of this assertion completely contradict the assertion; and it is because of the erroneous interpretations thereof by the lower Courts, which are so wholly inconsistent with the decisions of this Court, that the petition for writ of certiorari is so earnestly urged. And it is indeed remarkable that respondents here can so obviously ignore, and the Courts below can so casually sweep aside as mere *obiter dicta*, the express statements of this Court (in *Bauer* v. *O'Donnell*, 229 U. S. 1; and *United States* v. *General Electric Co.*, 272 U. S. 476) which so flatly contradict the assertion of respondents on which is predicated the hope of preventing a review of the present case by this Court.

3. With respect to point 3, we merely desire to comment upon respondents' attempt (Brief, p. 8) to differentiate the present case from the authorities cited in petitioner's brief by the statement that

> "Each of these cases involved intervening adverse rights of the defendant or some third party. In the present case there are no such intervening rights."

In making this assertion respondents must, of course, ignore the intervening *public* rights which this Court stressed in *Webster Electric Co.* v. *Splitdorf*, 264 U. S. 463, 472, and as to which, of course, respondents have no answer. As this Court has often stated (*e. g. Motion Picture Patents Case*, 243 U. S. 502), the public interest

> "is more a favorite of the law than is the promotion of private fortunes."

It is earnestly urged that the petition for writ of certiorari be granted.

Respectfully submitted,

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Respondents.

BRIEF FOR PETITIONER

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Respondents.

BRIEF FOR PETITIONER.

This is a patent infringement suit before this Court on writ of certiorari to the Circuit Court of Appeals for the Second Circuit.

Opinions of the Courts Below.

The opinion of the District Court for the Southern District of New York in this cause is reported in 16 Fed. Supp. 293 (Vol. III, p. 1618 *et seq.*). The opinion of the Court of Appeals for the Second Circuit, affirming the decree below, is reported in 91 Fed. (2) 922 (Vol. III, p. 1712 *et seq.*).

Jurisdiction.

The date of the judgment to be reviewed is August 2, 1937 (Vol. III, p. 1725 *et seq.*).

The writ of certiorari was granted by this Court on October 11, 1937.

The jurisdiction of this Court is invoked under Judicial Code 240-A as amended by the Act of February 13, 1935. The cases believed to sustain the jurisdiction are:

Motion Picture Patents Co. v. *Universal Film Co.*, 243 U. S. 502; 37 S. Ct. 416; 61 L. Ed. 871;

Carbice Corp. v. *American Patents Development Corp.*, 283 U. S. 27; 51 S. Ct. 344; 75 L. Ed. 819.

Assignment of Errors.

The errors which petitioner urges, are:

1. The Court of Appeals erred in holding, in effect, that the owner of a patent can, by means of the patent, restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor.

2. The Court of Appeals erred in holding, in effect, that a patent owner, merely by a "license notice" attached to a device made under the patent and sold in the ordinary channels of trade, can place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device.

3. The Court of Appeals erred in holding, in effect, that an inventor who has filed an application for

patent showing and describing, but not claiming, certain inventions, can, more than two years subsequent to public use of the said unclaimed inventions, by him or his assignee or licensee, file application for and obtain a valid patent for said inventions.

4. The Court of Appeals erred in failing to hold that by the acceptance and retention, by plaintiffs-respondents' authorized agent, of the royalties paid by the licensed manufacturer of the alleged infringing devices, plaintiffs-respondents were barred, under the equitable principles of acquiescence and estoppel, from maintaining this suit.

5. The Court of Appeals erred in failing to hold that each of the patents in suit is invalid as anticipated by or wanting of invention over prior patents in the art.

6. The Court of Appeals erred in failing to reverse the decree of the District Court and to order the dismissal of the bill of complaint in this case.

Statement.

The present suit constitutes a consolidation of three separate suits by respondents for alleged infringement of eight patents—four of the twelve patents included in the bills of complaint having been withdrawn at or prior to the trial.

Six of the patents (four Arnold patents, Mathes and Lowenstein) were found valid and infringed, and two (Arnold) were found invalid.

The case here involves only the six patents which were held valid and infringed.

In finding infringement by petitioner, which purchased and used but did not make or sell the devices embodying the inventions in suit, the Courts below dismissed the defenses (1) that petitioner had purchased these articles in the ordinary channels of trade from a manufacturer duly licensed to make and sell them; (2) that acceptance and retention of royalties for more than one year after suit commenced, with full knowledge of the use to which the articles were put, barred further maintenance of the action; and (3) that the patents were invalid.

The Facts.

(1) All of the patents in suit are included in a patent pool contributed to by respondents and the other large companies of the electrical industry, including Radio Corporation of America, General Electric Company and Westinghouse Electric and Manufacturing Company, which pool of patent rights has become popularly known as "the Radio Trust" (Vol. III, pp. 1305-1413).

By the pooling arrangement Radio Corporation of America was vested with the sole authority to grant licenses under all of the patents of the pool to manufacturers engaged in the manufacture and sale of apparatus embodying the inventions of the respective patents of the pool.

Under this authority, Radio Corporation of America, with respondent American Telephone and Telegraph Company joining as a co-licensor, granted to a number of apparatus manufacturers licenses under all of the patents in the pool, specifically including the patents in suit,

> "to manufacture * * *, and sell only for radio amateur reception, radio experimental reception, and radio broadcast reception * * *" (Vol. I, pp. 332-335; Vol. III, p. 1415).

One such manufacturer who acquired a license was the American Transformer Company, which, under its license, manufactured and sold apparatus technically known as a vacuum tube amplifier (Vol. III, p. 1414 *et seq.*).

(2) A vacuum tube amplifier is a standard piece of electrical equipment utilized for amplifying electric currents. It consists solely of the necessary electrical instrumentalities, including vacuum tubes, to which current is supplied to the "input" or "intake" end, and from which the amplified current is obtained from the "output" end. Obviously, an amplifier can be used for any purpose and in any industry where the amplification of an electric current is desired. The same standard instrumentality, therefore, can be utilized for perhaps hundreds of purposes in as many different industries.

(3) Pursuant to the requirement of paragraph 5 of its license agreement (Vol. III, p. 1418), the American Transformer Company attached to each of its amplifiers upon the sale thereof, a plate or label bearing the legend

> "License Notice—This apparatus is licensed only for radio, amateur, experimental and broadcast reception under the following patents of the Radio Corporation of America and associated companies"* Vol. II, p. 734).

As above noted the amplifier made and sold by the American Transformer Company can be used for any of many purposes for which amplifiers are used, other than those recited in the foregoing "License Notice".

(4) Petitioner, over a considerable period of time, and in the ordinary course of its business, purchased many

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* The patents in suit were included in the patents to which the "License Notice" applied.

hundreds of the amplifiers from the American Transformer Company with this "License Notice" attached thereto, and proceeded to employ them in talking motion picture projection equipment, being engaged solely in the business of making and leasing such motion picture equipment (Vol. I, p. 65, fols. 193-194). Petitioner never made or sold any amplifiers (Vol. I, p. 387, fol. 1160).

(5) The American Transformer Company, exercising its power of sale under the license, sold its amplifiers to petitioner, received its full selling price therefor, and paid its royalties to the Radio Corporation of America therefor under its license agreement with that company, reporting to the Radio Corporation of America the sales of the amplifiers made to petitioner (Vol. III, pp. 1568-1614). Petitioner was well known to Radio Corporation of America, and to respondents; they also knew that its business was confined exclusively to the making and leasing of talking motion picture equipment (Vol. I, pp. 65, 371, 379, 469, 476, 507).

(6) The present suit was instituted charging infringement of the patents in suit under which the amplifiers were manufactured and sold under license by the American Transformer Company, because the *use* to which petitioner put the amplifiers was outside the alleged "licensed" use specified in the "License Notice" attached to the apparatus. In other words, although tribute to the patents had been paid by the licensee, the patent owner, by a "notice" attached to the apparatus, sought to retain control over the *use* to which the amplifiers bought in the usual channels of trade from its licensee, and paid for, were subsequently put by the purchaser.

(7) For more than a year after the present suit was begun, Radio Corporation of America retained the royalties

paid by its licensee, the American Transformer Company, on the amplifiers sold by the licensee to petitioner, although throughout that period it was aware not only of the regularly continued sales of the amplifiers to petitioner by the American Transformer Company during such period, but also of the use to which petitioner put the amplifiers (Vol. II, p. 1216; Vol. III, pp. 1568-1614).

(8) Though this suit was commenced in September, 1929, and the license of American Transformer Company to make and sell these amplifiers did not expire until August, 1931 (Vol. III, p. 1421), the license was never cancelled nor was the American Transformer Company ever sued for any alleged breach thereof, and the American Transformer Company was permitted to continue to make and sell the amplifiers to petitioner, without interference, until the natural termination of its license (Vol. I, p. 344, fol. 1031; p. 349, fol. 1047).

(9) With reference to the merits of the patent, four of the six patents in suit issued to an inventor named Arnold. The application for each of the Arnold patents was filed more than two years subsequent to the widely publicized commercial use of the inventions thereof by American Telephone and Telegraph Company, in the first transcontinental telephone line between New York and San Francisco in January, 1915. The inventions of the Arnold patents have been used continuously in the transcontinental telephone line since that time (Vol. I, p. 102, fol. 305). Each of the Arnold patents purports to be either a "division" or a "continuation in part" of an application for patent filed by Arnold in September, 1915, but the "divisional" and "continuation" applications were not filed at the request of or required by the Patent Office, *and the inventions defined by the claims thereof were at no time claimed in the*

parent applications. In other words, although the inventions of the Arnold patents were shown and described in an Arnold application filed within two years of January, 1915, *no claim was ever made for the inventions constituting the subject matter of the four Arnold patents in suit as issued until more than two years subsequent to the widely publicized commercial use of these inventions by the American Telephone and Telegraph Company.*

Specifically, *Arnold Patent No. 1,329,283,* issued on an application filed July 30, 1918—*three years and six months after respondent's commercial use* (Vol. II, p. 628).

Arnold Patent No. 1,403,475, issued on an application filed November 11, 1920—*five years and ten months subsequent to respondent's commercial use* (Vol. II, p. 637).

Arnold Patent No. 1,448,550, issued on an application filed February 3, 1919—*four years and one month subsequent to respondent's commercial use* (Vol. II, p. 641).

Arnold Patent No. 1,465,332, issued on an application filed August 28, 1920—*five years and seven months subsequent to respondent's commercial use* (Vol. II, p. 644).

It will thus be seen that by these series of applications, all filed more than two years, and several of them nearly six years subsequent to commercial use of the inventions disclosed thereby, respondents have succeeded in extending the patent monopoly for the inventions far beyond the seventeen years contemplated by the statute.

(10) Finally, the subject matter claimed by the claims of the six patents here before the Court was disclosed by prior United States patents, and present no valuable invention thereover.

Questions Presented.

The foregoing facts present the following issues for determination by this Court.

1. Can the owner of a patent, by means thereof, restrict the *use* made of a device manufactured under the patent, after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor?

2. Can a patent owner, by means of the patent, merely by a "license notice" attached to a device made under the patent, and sold in the ordinary channels of trade by the patentee or by his licensee to make and sell, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device?

3. Could respondents' authorized agent accept and retain for more than a year after this suit was begun, and with full knowledge of petitioner's use, royalties paid by the licensed manufacturer on the alleged infringing devices it sold to petitioner, without being barred by acquiescence and estoppel from maintaining this suit?

4. Can an inventor who has filed an application for a patent, showing and describing *but not claiming* certain inventions, obtain a valid patent for said inventions by voluntarily filing a "divisional" or "continuation" application for said *unclaimed* inventions more than two years subsequent to public use of the said unclaimed inventions by him or his assignee or licensee?

5. Do the six patents in suit disclose patentable subject matter over prior disclosures of United States patents?

Petitioner's argument will be presented in the above order.

The Substance of the Opinion of the Court of Appeals Below.

The Court of Appeals for the Second Circuit answered all five of the questions in the affirmative.

With respect to the first and second questions, the Court of Appeals disregarded the numerous decisions of this Court on closely analogous questions * with the statement that the holdings of those cases are not necessarily controlling on the point here at issue (91 Fed. (2) 922 at p. 928; Vol. III, p. 1723). The pertinent statements of this Court in the *Boston Store* case (246 U. S. 8) and in the *General Electric* case (272 U. S. 476) were characterized as "obiter" (91 Fed. (2) 922 at p. 928; Vol. III, p. 1724); and the Court of Appeals concluded its opinion on this subject with the statement (91 Fed. (2) 922 at p. 929; Vol. III, p. (1724):

> "This circuit recognized that the patentee may extend his monopoly beyond a sale by a licensee."

With respect to the third question, the Court of Appeals, in holding that receipt and retention of royalties, even for a long period after suit was brought, constitutes no acquiescence, disregarded the rule of this Court in *Brant* v. *Virginia Coal & Iron Co.*, 93 U. S. 326, 336, that one retaining the fruits of a transaction will not be permitted to deny its validity. In *Vulcan Mfg. Co.* v. *Maytag Co.*, 73 Fed. (2) 136, to which the Court of Appeals referred as authority for its ruling on this point, this Court granted certiorari in a petition, urging *inter alia*, that acceptance of royalties

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* *Motion Pictures Patents Co.* v. *Universal*, 243 U. S. 502; *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Boston Store* v. *American*, 246 U. S. 8; *United States* v. *General Electric Co.*, 272 U. S. 476.

stituted a bar to the action (293 U. S. 553). The case s not argued, however, because the writ was dismissed stipulation (294 U. S. 734).

With respect to the fourth question, the Court of Ap- ls predicated its affirmative decision upon a distinction ween an inventor (and his assignee or licensee) and all er members of the public, holding that if a public use of invention of the patent occurred by the defendant in the gation, or by any other member of the public, more than years prior to the application for the divisional applica- n, the patent is invalid under Section 4886 R. S.; but, if h public use was by the inventor-applicant (or his as- nee or licensee), the statute is inapplicable (Vol. III, p. 2).

With respect to the fifth question, the Court of Appeals wered it in the affirmative, affirming the decision of the trict Court, with but scant consideration of the invali- ing prior art.

Argument.

At the outset, it should be borne in mind that this suit sists of an attempt, by means of the patents, to restrict use of a standard article of commerce made and sold reunder by a licensee under the patents. The attempted triction is not one which is in any sense inherent to the ucture of the article. In other words, whether or not the plifiers made and sold by American Transformer Com- ny were used for radio, amateur, experimental purposes, for broadcast reception, on the one hand, or were used any one of the hundreds of other purposes for which amplifiers could have been used, on the other hand, was rely a matter of the purchaser's option. For example,

the same amplifier could have been used for amplifying current in a railway signaling system, in a loud speaker system in an auditorium, for electrically recording phonograph records or the electrical reproduction thereof, in electro-medical laboratories, in power plants—in fact, in any industry where economical, substantial and reliable amplification of electric current is desired.

In essence, therefore, neither the uses of which the amplifier was capable, nor the purported restricted use to which the license notice sought to confine it, was dependent upon the particular construction or arrangement of the amplifier made and sold.

Certainly, the patent gives respondents no power to control the *use* to which *purchasers* of the amplifiers might put them. Otherwise it would be within the power of respondents (and, according to the contentions made by them in the courts below, it is a power they *assert* as within their right) in that way to parcel out the single monopoly of their patent into an unlimited number of sub-monopolies, one for each possible use for the amplifier. Of course, this cannot be done. Long ago, in a case in which the facts in this respect, at least, were like those here presented (*Washing Machine Co.* v. *Earle*, 29 Fed. Cas. 17219, p. 332), the Circuit Court pointed out the impropriety and invalidity of any attempt to multiply the single monopoly of a patent by any such sub-division thereof, thereby to control the various uses to which the article, after its sale, might be put. The Court said (p. 334):

> "Goodyear, by virtue of his patent, might have manufactured it (vulcanized rubber) all himself, and sold it for such price as he could get; *but his patent gives him no power to control the use which persons who purchase may make of it. Vulcanized rubber may be*

> *applied to a thousand purposes, from a tube to a steam engine, but this patent gives no power to the patentee to parcel out his one monopoly into a thousand sub-monopolies.*" * (Matter in parenthesis ours.)

In consequence, the first question presented in this cause goes squarely to the legality of the attempted restriction which respondents, by means of their patents, seek to impose upon the use to which petitioner may put the amplifiers it has purchased from a manufacturer licensed to make and sell them.

POINT I.

The owner of a patent cannot, by means of the patent, restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade and full consideration paid therefor.

The Court of Appeals for the Second Circuit expressly held (91 Fed. (2) 922, 929; Vol. III, p. 1724):

> "* * * the patentee may extend his monopoly beyond a sale by a licensee."

Thus, its decision is to the effect that a patentee may, by means of the patent, maintain a control over the patented article after its sale and full consideration paid therefor, and hold the purchaser as an infringer if the article is used other than as prescribed by a mere "notice" attached to the article when sold. If this decision is sound, the owner of a

* Italics in this brief are ours.

patent for an ordinary pocket lighter (sold across the counter in any retail cigar store) can attach a notice thereto that the lighter is licensed for use only for lighting cigarettes, and successfully maintain a suit for infringement against the purchaser if he uses it for lighting cigars. The absurdity of the logical and practical consequences of the decision in the case at bar will thus be seen.

This suit is concerned with talking motion picture equipment and therefore involves the same industry which this Court in the *Motion Picture Patents* case, 243 U. S. 502, 519 said "must be recognized as an important element in the amusement life of the nation". It is the same industry and the same equipment with respect to which these respondents have already been found to have established and maintained an illegal monopoly in violation of the anti-trust laws. (See *Stanley Company of America, Inc.* v. *American Tel. & Tel. Co. et al.; General Talking Pictures Corporation* v. *American Tel. & Tel. Co.; Duovac Radio Corporation* v. *American Tel. & Tel. Co.* preliminary injunction granted 4 Fed. Supp. 80; on final hearing, 18 Fed. Supp. 650.)

To proceed a step further, then, the ruling by the Court of Appeals quoted at the commencement of this Point, would in effect make of the patent law the "perfect instrument of favoritism and oppression" (*Motion Picture Patents* case, 243 U. S. 502, 515). In evolving and applying for almost one hundred years, a doctrine precisely to the contrary of that expressed by the Court of Appeals, and holding that a sale exhausts the monopoly of the patent owner as to the particular article involved, this Court, following *Kendall* v. *Winsor*, 21 How. 322, has invariably interpreted the patent law so as to consider "the benefit to the public or community at large" * * * as "the primary object in granting

and securing that monopoly," rather than "the promotion of private fortunes" (*Motion Picture Patents* case 243 U. S. 502, 511, 519).

A. Outline of the progressive establishment of the rule by this Court that the sale of a patented article by the patent owner or by a licensee having a power of sale, removes the article from the patent monopoly.

(1) This principle was first expressed and applied so as to give a right of use unlimited in point of time, to one who had purchased a patented article from a person whose patent rights, either as owner or territorial assignee, were expressly limited to the original term of the patent. In those cases, therefore, the holder of the extended term was held to have no rights with respect to the article so purchased.*

(2) The rule was thereupon extended to cases involving purchases of patented articles from territorial assignees who themselves had no right to make, sell or use outside the territory to which they were restricted. It was there held (a) that the *purchasers* were not bound under the patent laws by the territorial restrictions of their vendors, and could use the articles elsewhere †; (b) that such vendors were not chargeable with infringement for deliberately selling for use in other territory ‡; and (c) that dealers who purchased such patented articles from territorially limited vendors, could sell or use them elsewhere as well, free from the monopoly of the patent.§ In each of the cases it was

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* *Wilson* v. *Rousseau*, 4 How. 646; *Simpson* v. *Wilson*, 4 How. 709; *Bloomer* v. *McQuewan*, 14 How. 539; *Bloomer* v. *Millinger*, 1 Wall. 340.

† *Adams* v. *Burke*, 17 Wall. 453.

‡ *Hobbie* v. *Jennison*, 149 U. S. 355.

§ *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659.

held that though all of the parties concerned had full knowledge of the vendor's restricted rights, the purchasers of the patented articles nevertheless took free of all restrictions under the patents.

(3) Thereupon the attempt by patentees to retain control over patented articles after their sale, by the device of express restrictions in the guise of "license notices" or special agreements with the vendor, intended to enable the patentee to control the resale prices * or the use of those articles by the purchaser,† met with a like fate (See Point II). In each, as this Court stated in the *Boston Store* case, the reason for the decision was the simple but fundamental ground that, title to the patented article having passed, the monopoly of the patent law cannot "be extended beyond the scope of that law, or, in other words, applied to articles after they have gone beyond its reach" (246 U. S. 8, 26).

B. Analysis of cases in which the rule was considered or applied.

From the summary just concluded, it is evident that every attempted restriction on a patented device after it has been sold, by means of the patent under which it was made, has been invalidated by this Court on the ground that a sale exhausts the monopoly of the patent owner as to the particular article involved.

1. *Attempted Restrictions on Time of Use.*

Thus, in *Wilson* v. *Rousseau*, 4 How. 646, and *Simpson* v. *Wilson*, 4 How. 709 (1846), this Court held that one who

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* *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8.

† *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502, overruling *Henry* v. *A. B. Dick Co.*, 224 U. S. 1.

purchased a patented article from a patent owner during the original term of the patent, continued to have the right to use it beyond any limitation in time, though the rights of assignee of the original patent itself were held to have expired with the term as against the claims of one who had obtained an extension of the patent term under the then existing law. These cases lay the foundation of the rule that the sale of a patented chattel exhausts the patent rights of the seller.

This rule was redefined and again applied six years later in *Bloomer* v. *McQuewan*, 14 How. 539 (1852), in another case dealing with an attempted restriction on the *time of enjoyment*. It was there held that the purchaser of a patented article during the period to which the patent was first limited, was entitled to continue to use it during the extended term, though the right of his vendor,—a territorial assignee—in the patent itself, was confined to the original term. This Court thereupon distinguished between the grant of a patent right such as the *license*, on the one hand, and the *sale* of an article made under that right, on the other hand. Chief Justice TANEY, who wrote the prevailing opinion in this and the earlier *Wilson* cases, *supra*, stated this distinction to be "a plain one", and held (p. 549):

> "* * * the purchaser of the implement or machine for the purpose of using it in the ordinary pursuits of life, stands on different ground. In using it, he exercises no rights created by the act of Congress, nor does he derive title to it by virtue of the franchise or exclusive privilege granted to the patentee. * * * *And when the machine passes to the hands of the purchaser, it is no longer within the limits of the monopoly.*"

2. *Attempted Restrictions on Place of Use.*

The problem was presented anew in three cases between 1873 and 1895, but this time from the viewpoint of attempted restrictions on the *place of use* of patented articles after sale. In each instance this Court held that such restrictions would not be recognized by the patent law once the patented articles had passed by sale into the channels of trade.

Thus, in *Adams* v. *Burke*, 84 U. S. 453 (1873), it was held that one who purchased a patented article in the restricted territory of his vendor, acquired the unrestricted right to use it anywhere. This Court held in that case (84 U. S. 453, 456):

> "But, in the essential nature of things, when the patentee, or the person having his rights, sells a machine or instrument whose sole value is in its use, he receives the consideration for its use and he parts with the right to restrict that use. The article, in the language of the court, passes without the limit of the monopoly."

In *Hobbie* v. *Jennison*, 149 U. S. 355 (1893), it was held that a patent assignee for one territory was not an infringer when he sold to a person who, to his knowledge, intended to use the patented articles so purchased, in the territory of another assignee. The plaintiff in the *Hobbie* case sought to escape the implications of the decision in *Adams* v. *Burke* by asserting that in the *Adams* case the vendor of the patented device was unaware of the allegedly unauthorized use to which the purchaser put the article, but this Court, after stating that there was full knowledge by all parties in both cases, held (*Hobbie* v. *Jennison*, 149 U. S. 355, 363):

> "But we are of opinion that the case of *Adams* v. *Burke* cannot be so limited; * * * and that neither the actual use of the pipes in Connecticut, or a knowledge on the part of the defendant that they were intended to be used there, can make him liable."

The question then arose in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659 (1895), whether a *dealer* could be restrained from selling patented articles in his store in Massachusetts, having purchased them from the Michigan assignee with knowledge that the right to make, use and sell them for Massachusetts belonged to another. This Court refused to hold the dealer as an infringer, stating, in effect, that a free citizen may buy anywhere, and, being the owner of what he buys, may sell it anywhere. Reviewing *Adams* v. *Burke* and *Hobbie* v. *Jennison*, this Court held (pp. 666-667):

> "Upon the doctrine of these cases we think it follows that one who buys patented articles of manufacture *from one authorized to sell them* becomes possessed of an absolute property in such articles, unrestricted in time or place. * * *
>
> The conclusion reached does not deprive a patentee of his just rights, because no article can be unfettered from the claim of his monopoly without paying its tribute. The inconvenience and annoyance to the public that an opposite conclusion would occasion are too obvious to require illustration."

3. *Attempted Restrictions on Resale Prices and Use:*

The doctrine of the foregoing cases was restated and reapplied in *Bauer* v. *O'Donnell*, 229 U. S. 1 (1913); *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490 (1917); *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8 (1918), and *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502 (1917), of which cases the three first named were concerned with the efficacy of attempted *resale price* restrictions and the fourth with attempted limitations on *use*. In each of these cases (considered more fully in Point II of this brief), the patent owner sought to accomplish, by the

device of "license notices" attached to patented articles after their sale, what this Court had refused to sanction in the earlier decisions we have just reviewed. Here, too, this Court, on the same principle which governed its decisions in those earlier cases, invalidated the devices as an attempt to project the patent monopoly beyond its rightful scope.

Thus, in passing upon attempted restrictions as to *resale prices* in *Bauer* v. *O'Donnell*, 229 U. S. 1, this Court held (p. 17):

> "The right to vend conferred by the patent law has been exercised, and the added restriction is beyond the protection and purpose of the act. This being so, the case is brought within that line of cases in which this court from the beginning has held that *a patentee who has parted with a patented machine by passing title to a purchaser has placed the article beyond the limits of the monopoly secured by the patent act.*"

Some years later, this Court summarized its prior decision in *Bauer* v. *O'Donnell* in words strikingly apposite now, in the case of *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8, 23:

> "In other words, the decision was that *a patentee could not use and exhaust the right to sell, as to which a monopoly was given him by the patent law, and yet by conditions and stipulations continue that law in effect so as to make it govern things which by his voluntary act were beyond its scope.* And * * * as a result, where an article has been sold and passed beyond the monopoly given by the patent law, remedies on the theory of infringement were not applicable to acts done which could not have that character * * *."

In the same case, speaking of the rejection of attempted *use* restrictions in the *Motion Picture Patents* case, 243 U. S. 502, this Court continued (p. 25):

> "Reiterating the ruling in the two last cases, (referring to *Bauer* v. *O'Donnell* and *Straus* v. *Victor Talking Machine Co.*) it was again decided that, as by virtue of the patent law, *one who had sold a patented machine and received the price, and had thus placed the machine so sold beyond the confines of the patent law, could not by qualifying restrictions as to use, keep under the patent monopoly a subject to which the monopoly no longer applied.*"

Finally, in the case of *United States* v. *General Electric Company*, 272 U. S. 476 (1926), this Court said at page 489:

> *"It is well settled, as already said, that where a patentee makes the patented article and sells it, he can exercise no future control over what the purchaser may wish to do with the article after his purchase. It has passed beyond the scope of the patentee's rights."*

Summary.

These decisions show a consistency in ruling which is outstanding in the respect that it has not been departed from or modified, regardless of the guise in which attempted restrictions have been presented.

The fundamental reason underlying all of the decisions appears to be the simple fact that this Court recognized and gave full effect to the fact that when the patented article was sold and the price paid, the article was forever outside the monopoly of the patent, and became, like any ordinary chattel,* owned by the purchaser, to be used or done with

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* *Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373, citing with approval *Park & Sons-Hartman*, 153 Fed. 24, 39 in which it was held that "a covenant which may be valid and run with land will not run with or attach itself to a mere chattel". See, to the same effect, *Taddy* v. *Sterious*, L. R. (1904) 1 Ch. 354, 358; and *Barker* v. *Stickney* (1919), 1 K. B. 121, 132.

as he saw fit, without hindrance by or under the control of the patent owner.

Therefore, for each and every one of the reasons so clearly stated in the foregoing decisions of this Court, the attempted restriction in the present case should be as emphatically rejected and invalidated, and the decision of the Second Circuit Court of Appeals reversed, and the cause remanded to the District Court with instructions to dismiss the bill.

POINT II.

A patent owner, merely by a "License Notice" attached to a device made under the patent and sold in the ordinary channels of trade, cannot, by means of the patent, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device.

A. Application of the Rule to "License Notice" cases.

When this Court, in its decisions from *Bloomer* v. *McQuewan*, 14 How. 539 to *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, construed the exercise of the right to vend under the patent law as granting to the purchaser of the patented article full title without permitting the patent owner to retain the incidents of it, patent owners renewed their battle to fasten control on patented articles after their sale, by the device of attaching "License Notices" to those articles, or by restrictive agreements with the purchasers. However, that method fared equally badly, for this Court with unfailing regularity brushed aside "the guise of license or otherwise" (*Boston Store* v. *American Graphophone Co.*, 246 U. S. 8, 24) and refused to hold such purchasers as infringers.

Some time before the "license notice" issue was presented to this Court in patent cases, it had decided against the practice in the closely analogous copyright cases of *Bobbs-Merrill* v. *Straus*, 210 U. S. 339 and *Scribners* v. *Straus*, 210 U S. 352, in which resale price restrictions by "notice" on copyrighted books, after their sale, were held void. The use of such "license notices" on sold patented articles was termed "dangerous doctrine" by a former Assistant Commissioner of Patents,* who observed and warned against the material growth of such practice, and its occasional support in the lower Federal Courts before 1912. When the question did come before this Court the entire system of "license notice" restrictions sought to be attached to patented articles upon their sale, was finally repudiated in its entirety.

1. *Attempted "License Notice" Restrictions on Resale Prices.*

In *Bauer* v. *O'Donnell*, 229 U. S. 1, the first of the series of patent cases in which the issue was raised, a retail drug store proprietor was sued for patent infringement for having disregarded a notice on original Sanatogen packages he purchased, purporting to license their "sale or use at a price not less than one dollar". The notice also recited the purchase as constituting an acceptance of the condition, with right of reverter in the event of violation.

The case came up on certificate from the Court of Appeals of the District of Columbia and "the question presented restricted the case to determining whether the right to limit the price existed because within the monopoly granted by the patent law" (*Boston Store* v. *American*

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* Walter H. Chamberlain in 6 Illinois Law Review 357 (January, 1912).

Graphophone, 246 U. S. 8, 22-23, interpreting the *Bauer* decision).

In deciding that no right under the patent law was involved, and that the purchaser was free to use the patented article at will, Mr. Justice DAY, writing for this Court, said (229 U. S. 1, 13):

> "The sale of a patented article is not essentially different from the sale of a book. In each case to vend is to part with the thing for a consideration."

In reaching the conclusion that once the right to vend, conferred by the patent law, has been exercised, "the added restriction is beyond the protection and purpose of the act" (229 U. S. 1, 17), this Court expressly predicated its decision *inter alia*, on *Bloomer* v. *McQuewan*,* *Adams* v. *Burke*,† and *Keeler* v. *Standard Folding Bed Co.*,‡ thus bringing its decision precisely in line with the doctrine *fundamental* to all those cases, that once title to a patented article has passed to a purchaser, and the right to vend thus exhausted with respect thereto, the article has passed "beyond the limits of the monopoly secured by the patent act" (*Bauer* v. *O'Donnell*, 229 U. S. 17).

In *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490, this Court was next called upon to decide the legal effect of a "License Notice" affixed to a patented machine. The Victor Company manufactured phonographs and distributed them under "license contracts", reserving title to the machine until expiration of its patent and compliance with certain conditions appearing on a "License Notice". This license authorized dealers to convey a license to use the machine upon a minimum payment of $200. The defendant

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* 14 How. 539.
† 84 U. S. (17 Wall.) 453.
‡ 157 U. S. 659.

bought a quantity of the machines at less than the fixed price stated in the "License Notice". The Victor Company sought to enjoin this alleged infringement by preventing the defendant from selling them, presumably at lower prices.

This Court, in dismissing the bill for infringement, held the "Notice" invalid, and the full purport of its holding was later summarized in the following language in *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8, 24:

> "Basing its action upon the substance of things, and disregarding mere forms of expression as to license, etc., the court held that the contract was obviously * * * not different from the one which had come under review in *Bauer* v. *O'Donnell*. Thus brushing away disguises resulting from forms of expression in the contract, and considering it in the light of the patent law, it was held that the attempt to regulate the future price or the future marketing of the patented article was not within the monopoly granted by the patent law * * *"

It is interesting to note that this Court, undeceived by the patentee's use of the word "license" to cloak what was really a sale, found that the facts involved an attempted price restriction on patented articles "after they have passed into the possession of dealers and of the public", and held:

> "We conclude that it falls within the principle of *Adams* v. *Burke*, 17 Wall. 453, 456, and of *Bauer* v. *O'Donnell*, 229 U. S. 1."

Adams v. *Burke*, on the page indicated in the *Straus* opinion, holds that upon sale "the article, in the language of the Court, passes without the limit of the monopoly"

("the language of the Court" refers to *Bloomer* v. *McQuewan*, 14 How. 539). That, also, is the principle restated in *Bauer* v. *O'Donnell*. Price limitation was no issue in *Adams* v. *Burke*, or *Bloomer* v. *McQuewan*. The only principle common to the *Adams*, *Bloomer*, *Bauer*, and *Straus* cases is that a *sale, whether with or without a license notice, takes the patented article out of the patent monopoly.*

Thereafter, in *Boston Store of Chicago* v. *American Graphophone*, 246 U. S. 8, the "license notice" method which had failed of recognition in the *Bauer* and *Straus* v. *Victor* cases, was supplanted by *written contracts* between marketing agents of the patentee and purchasers of the patented articles whose resale prices were sought to be controlled thereby.

The District Court in that case conceded that a patentee

> "cannot make a notice attached to the article discharge the function of a 'covenant running with the land'" (225 Fed. 785, 787)

but was misled by the contract device, and sustained the bill alleging patent infringement because of a violation of that agreement.

This Court, however, on a certificate from the Circuit Court of Appeals for the Seventh Circuit in that case, inquiring whether "the recited facts disclose that some right or privilege granted by the patent laws has been violated" answered in the negative and dismissed the bill. After reviewing its prior decisions invalidating restrictions sought to be imposed under the patent law on patented articles after their sale, this Court held (p. 25):

> "Thus concluding, it becomes, we think unnecessary to do more than say that we are of opinion that the attempt in argument to distinguish the cases by the

> assumption that they rested upon a mere question of the form of notice on the patented article, or the right to contract solely by reference to such notice, is devoid of merit, since the argument disregards the fundamental ground upon which, as we have seen, the decided cases must rest."

That "fundamental ground" of which this Court spoke, was that the monopoly of the patent cannot (p. 26):

> "be extended beyond the scope of that law or, in other words, applied to articles after they have gone beyond its reach."

Indeed, so firmly did this Court deem that rule to be established that it expressly rejected any further attempts "judicially to correct doctrines which by reiterated decisions have become conclusively fixed" (p. 26).

2. *Attempted "License Notice" Restrictions on Use.*

The doctrines of the foregoing cases were again presented to this Court, but from a different aspect, in *Henry* v. *A. B. Dick Co.*, 224 U. S. 1, and *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502. In those cases renewed attempts were made by patent owners to control patented articles in the hands of purchasers, this time by "license notices" attached to the articles and purporting to restrict their *use*.

In the *Dick* case, by a four to three decision, such a notice, requiring the patentee's unpatented supplies to be used with the patented device, was held effective and its violation recognized as an infringement of the patent. That conclusion was arrived at by reasoning that if a patentee by virtue of his patent, could *reserve all* uses, he surely could *restrict some* on articles made and sold under the patent. The fallacy in that argument was, of course, that it failed

to recognize that rights with respect to all of the parts collectively, are not necessarily rights with respect to any isolated part. Therefore, though the right to make, vend or use could be reserved or granted in part, it could not follow a patented article into the hands of a *purchaser* as a restriction in the nature of "a license of the *use*", to quote from this Court's analysis of the *Dick* decision, in the *Boston Store* case (246 U. S. 8, 22).

This entire question was re-examined, however, and the *Dick* case was expressly overruled in the *Motion Picture Patents* case. There this Court had presented to it two closely analogous questions—(1) whether a patentee who licenses the manufacture and sale of the patented device can, by a mere notice attached to the article, limit the purchaser from such licensee to films which were not part of the patented machines, and (2) whether the patentee, by a mere notice so attached, can reserve conditions to be fixed in the future.

Both questions were answered in the negative by this Court. With respect to the "License Notice", it held (p. 509):

> *"The statutes relating to patents do not provide for any such notice and it can derive no aid from them".*

This Court thereupon proceeded to hold that (p. 516):

> "• • • it is not competent for the owner of a patent by notice attached to its machine to, in effect, extend the scope of its patent monopoly by restricting the use of it to materials necessary in its operation".

(To same effect, see the later case of *Carbice Corp.* v. *Amer. Patents Development Corp.*, 283 U. S. 27.)

In reaching this result, this Court held that the exclusive right to *use* is no greater than the exclusive right to *vend* a patented machine and that its previous decision in *Bauer* v. *O'Donnell* had interpreted the exercise of the right to vend, as freeing the article "of every restriction which the vendor may attempt to put upon it" (*Motion Picture Patents* case, 243 U. S. 502, 516).

Of course, there is no distinction in principle between attempting to restrict the materials to be used by an attached "License Notice", and attempting to restrict the use of the device itself. Both of the attempted restrictions consist of nothing more or less than attempts on the part of the patent owner to "extend the scope of its patent monopoly" in a manner neither contemplated nor permitted by the patent statutes.

The only distinction that exists between the decisions of this Court in the *Bauer, Straus, Boston Store* and *Motion Picture Patent* cases, on the one hand, and the case at bar, is in the *character* of the restrictions sought to be effected by the "License Notice" attached to the goods sold. Because of the fact that the Court of Appeals differentiates the cases in this fashion when there is and should be no distinction between them, renders it necessary for this Court to clarify the situation by a decisive holding (in accord with its decisions), that *no* valid restriction on the use of a patented article purchased from the patentee or his licensee, and the price paid therefor, can be effected by a mere "License Notice" attached to that article.

B. Extra-Judicial Comment on the extent of the Rule.

The force and extent of the rule, as established and applied in the foregoing cases, is fully reflected in the references to it made by leading writers on the law of patents.

Thus, Professor Williston has recently stated (5 Williston on Contracts, 1937, pp. 4630-31):

> "• • • It seems, indeed, to have been suggested by the Supreme Court of the United States, that as to patented articles there is an inherent inconsistency in selling property and imposing a restriction on the buyer (citing the *Boston Store* case). This can only mean, however, that the patent laws give no protection to restrictive promises exacted from a *buyer* and that they must stand or fall under the common law as if the article was unpatented. • • • Certainly, this result cannot be achieved by mere notices on patented articles." (Citing the *Straus* v. *Victor, Motion Picture Patents* and *Carbice* cases.)

Professor Chafee, commenting on this Court's decision in those cases, also points out (41 Harvard Law Review 945, 1002):

> "When the patented article is sold it appears to pass outside the scope of the patentee's monopoly in every respect. At least I find no satisfactory case to the contrary."

And, in Walker on Patents (1929), Vol. I, the rule is summarized in the following language (p. 425):

> "But the purchaser of a patented apparatus from the owner of the patent thereon, acquires whatever right that patent covers, to use that apparatus in accordance therewith, even where it is capable of a different use, and *by such sale the apparatus is thereby rendered free of every restriction which the patentee may attempt* to put upon it". (Citing *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502.)

C. The Court of Appeals erred in treating as "obiter" and "not necessarily controlling", the doctrine of this Court that under the patent law no future control by "license notice" or otherwise can be exercised over a patented article once it has been sold.

The Court of Appeals in the case at bar "suggests" that although this Court plainly said in the *Bauer, Straus* and *Boston Store* cases that it was deciding the issues there involved *solely under the patent law,* the real reason was a policy against resale price control (Vol. III, p. 1724). It rests that suggestion on a purported quotation from the *Boston Store* opinion, which we have been unable to find. However, what this Court did say there was that the particular contract "disclosed in the certificate" in the *Boston Store* case (246 U. S. 8, 25), was also void under the general law as in restraint of trade (*Dr. Miles Medical Co.* v. *Park & Sons,* 220 U. S. 373), and that it was incapable of being made good by resort to the patent law "under the guise of a patent infringement".

To be sure, public policy at common law prohibits resale price restrictions on the sale of chattels in the ordinary course of trade, but it does not follow, when such restrictions are sought to be enforced in the form of an infringement suit simply because the articles were made and sold under a patent, that the only reason they are held void is because of public policy. They are held bad under the *patent law* for the simple reason that *no* restrictions on patented articles after their sale have ever been recognized by this Court (except in the *Dick* case, which was overruled by the *Motion Picture Patents* decision). *A fortiori,* restrictions inherently invalid under the general law, will surely find no protection under the patent statute on any theory.

The vice in the holding of the Court of Appeals below becomes ever more apparent when it is recalled that where the free movement of chattels in the hands of purchasers in the ordinary channels of commerce is not involved, price restrictions have always been held *good* under the patent law. Thus, in cases involving *simple licenses* to make, use or vend, where the mutual rights of patentee and licensee are considered, as distinguished from transactions constituting *sales* of patented articles, the patent law permits the imposition of all manner of restrictions not in themselves illegal or violative of some special statute (*United States* v. *United Shoe Machinery Co.*, 258 U. S. 451; *Patterson* v. *Kentucky*, 97 U. S. 501). This Court has, therefore, recognized price and other restrictions *as between a patentee and his licensee*, where the license was a true one, and not a subterfuge for a sale (*Bement* v. *National Harrow Co.*, 186 U. S. 70; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32; *United States* v. *General Electric Co.*, 272 U. S. 476).

Hence, in the *Bement* case, price fixing restrictions were held valid in a contract between a patentee and its manufacturing licensee, even against the Sherman Act, a rule of decision followed in the first *Shoe Machinery* case (247 U. S. 32). This Court in the last named case recognized the distinction to be drawn between grants of parts of a patent monopoly, such as a *license*, on the one hand, and *sales* of patented articles on the other, when it held that the patentee (p. 58):

> "* * * has the power of granting it (his invention) to some and withholding it from others, a right of selection of persons and of terms. There is, however, a limitation upon him; *he cannot grant the title and retain the incidents of it.*" (Matter in parenthesis ours.)

In the *General Electric* case, this Court, distinguishing between agencies to sell and actual sales of patented articles, held that agreements by the *General Electric Co.* with its licensee "as to the prices at which the latter shall sell articles he makes * * * are valid". In other words, if a patentee grants a *license* to make and sell, he may require the licensee to "limit the selling by limiting the method of sale and the price". However, he can place no such restriction upon one who has *purchased* the patented article from the licensee (272 U. S. 476, 490). Thus, this Court held (p. 485):

> "As long as he (the patent owner) makes no effort to fasten upon ownership of the articles he *sells* control of the prices at which his purchaser shall sell, it makes no difference how widespread his monopoly." (Matter in parenthesis ours.)

To summarize, it is obvious, then, that when this Court in *Bauer* v. *O'Donnell*, 229 U. S. 1, held resale price restrictions invalid on patented articles which had been sold, it was simply because the patent law * permits no restrictions on patented articles after their sale. If public policy were the test, then the price fixing restrictions upheld in the *Bement* and *General Electric* cases (*supra*) should have been invalidated. Such restrictions were held good, however, in those cases simply because this Court there had to deal solely with the enforceability of *license agreements* as distinguished from *sales*. Recently, in *Old Dearborn Distributing Co.* v. *Seagram Distillers Corporation*, 299 U. S. 183, in upholding the Illinois Fair Trade Practice Law, this Court again stated that in the *Boston Store* and *Bauer* cases it had invalidated attempted restrictions on patented articles that had passed by sale into the ordinary channels

* See Rev. St., Sec. 4884, reproduced in full, Appendix, p. 70.

of trade simply because the patent law afforded no basis for upholding any such restrictions and that resort must be had to an amendment of the law to accomplish any such purpose.

So, also, the Court of Appeals below erred in holding that public policy alone moved this Court to declare invalid the "license notice" restrictions in the *Motion Picture Patents* case, 243 U. S. 502. Public interest was indeed one of the *two* reasons stated, but the other was that the purported restriction was "plainly void, because wholly without the scope and purpose of our patent laws" (p. 519).

D. Respondents' contentions as to the "scope" of the license of their vending licensee.

Respondents asserted in the Courts below, and the Court of Appeals agreed, that the sales of the patented amplifiers to petitioner, though by one licensed to make and sell, was beyond the "scope" of the license and therefore an infringement of the patent just as though a license had never existed. It requires but little discussion to establish the want of merit in this contention.

In the first place the fact that the licensee undeniedly had the right to *sell* is a complete answer. It is equally true that to each amplifier made and sold by it to petitioner, there was attached a "license notice" precisely as set forth in its license agreement with respondents. If the licensee, in exercising his right to sell, is claimed, nevertheless to have breached some express covenant in his license agreement, the remedy—and the only remedy—of the licensor lay in a suit against the licensee because of the breach. No cause of action—and certainly not one under the patent law—would lie against the purchaser. This was expressly held in *Mitchell* v. *Hawley*, 11 Fed. Cas. 883, 885 (affirmed by this

Court in 16 Wall. 544). There the Circuit Court, in passing upon a license to make and *use*, said—

> "He (the licensee, Bayley) never acquired the right to sell a single machine * * *. Had he * * * possessed the power to sell the patented machines, the purchaser would have acquired a title which would have been outside of the monopoly, and would have acquired the absolute right to use the machines during the extended term; *and this notwithstanding any covenants Bayley might have made not* to convey such a title. Under such circumstances the patentee must have sought his remedy against Bayley on his covenants." (Matter in parenthesis ours.)

Nor is respondents' contention strengthened by the attachment of the "license notice" to the amplifiers sold by their licensee, as has been established by the prior decisions of this Court hereinabove discussed. Restrictions sought to be imposed by a "license notice" attached to the article when sold have been emphatically rejected and decisively invalidated as an unwarranted attempt to extend the monopoly of the patent to articles made and sold thereunder that have passed beyond its reach into the hands of purchasers. Surely, it cannot be seriously or successfully urged that what the patentee himself cannot do, he can nevertheless accomplish through the medium of a licensee empowered to make and sell the article with such "license notice" attached.

At common law the passage of title to chattels in the ordinary channels of trade is generally held to be incompatible with continued control over them by the seller (*Taddy* v. *Sterious L. R.* (1904) 1 Ch. 354, 358). The rule is not different because the manufacturer of the article chose to sell it through an agent or jobber with instructions

to attach, by label or notice, limitations on its use or resale (*Dr. Miles Medical Co.* v. *Park & Sons,* 220 U. S. 373). In the *Dr. Miles* case, this Court held (p. 408):

> "It is an article of commerce and the rules concerning the freedom of trade must be held to apply to it."

Likewise, respondents' argument is not strengthened by the fact that in the present case the manufacturing licensee knew that the amplifiers it sold to petitioner were to be used in the motion picture industry. If, under the patent law, license notice restrictions are invalid as against purchasers of patented articles, as repeatedly held by this Court, then surely knowledge that the articles were to be used for the purposes allegedly reserved by the notice or outside of the alleged scope of the right of the seller, would not make any difference, and this Court has expressly so held (*Hobbie* v. *Jennison,* 149 U. S. 355).

Moreover, as would be expected, respondents' contention that the sales of the patented articles by the licensed manufacturer were beyond the alleged scope of the license to make and sell because of the fact that the articles were used in a field other than as specified by the license agreement with its manufacturing licensee as well as by the "license notice", is the same contention that has been made by the patent owner, so far as we have observed, in every case cited in this brief where sales of patented articles were made by one vested with a power of sale.

Indeed, it is quite obvious that the question involving the legality of an attempted restriction on a patented article after it has been sold, and the price paid therefor, could not have arisen under the charge of infringement unless the defendant in each of those cases had, according to the patent

owner's argument, at least, stood in the shoes of an infringer who was not vested with the immunity from suit incident to a license.

Thus, in *Adams* v. *Burke,* 84 U. S. (17 Wall.) 453, Burke *knew* of his vendor's restricted right to sell and use and yet receive by purchase the right to use the patented article beyond the territorial limits of his vendor. In fact, the dissenting Justices in that case stood precisely on the argument here made by respondents, when they stated (pp. 458-459, 460):

> "If it be contended that the right of vending the lids to others enables them to confer upon their vendees the right to use the lids thus sold outside of the limited district, the question at once arises, how can they confer upon their vendees a right which they cannot exercise themselves? * * * In my judgment it was limited in locality, both as to manufacture and use, and that he could not convey to another what he did not have himself."

In *Hobbie* v. *Jennison,* 149 U. S. 355, the territorial assignee of a patent right *deliberately* sold the patented article made thereunder, for use in the territory of another assignee, so that the purchaser received that which the vendor did not himself possess. This Court there expressly held (p. 363):

> "that *neither the actual use of the pipes in Connecticut, or a knowledge on the part of the defendant that they were intended to be used there, can make him liable.*"

And, in *Keeler* v. *Standard Folding Bed Co.,* 157 U. S. 659, there was established the right of the purchaser to sell outside of his vendor's territory even though the vendor could not do so himself.

Similarly, the same contentions were made with respect to attempted restrictions as to resale price (*e. g., Straus* v. *Victor,* 243 U. S. 490) where the resale price was specified by the license, and sales were made of the patented device at prices less than those specified. The sales were charged to constitute "infringement" of the patent and the seller was charged to be an infringer as though no license ever existed.

Finally, in the *Motion Picture Patents* case, 243 U. S. 502, closely analogous to the present situation both as to subject matter and facts, where, too, the licensee to manufacture and sell was required to affix "license notices" to the machines it sold purporting to limit their use in the hands of purchasers, this Court held that the purchaser took free of the attempted restrictions and was not an infringer. It thereby disposed of the contention there made that his purchase was not a *licensed* act, or that the terms of the license had been exceeded by an allegedly unauthorized sale. In pointing out that the patent law has no application to cases of that character this Court further held (p. 509):

> "The extent to which the *use* of the patented machine may validly be restricted to specific supplies *or otherwise* by special contract between the owner of a patent and the purchaser or licensee is a question *outside the patent law* and with it we are not here concerned."

In the end, therefore, it nevertheless remains true that though a *licensee* may be restricted to *use* the invention of an article in a special field, or for a particular purpose (*Rubber Co.* v. *Goodyear,* 9 Wall. 788),—*once sold,* either by the patentee or by a licensee to make and *sell,* that same article can be used for any purpose (*Washing Machine Co.* v. *Earle,* 29 Fed. Cases No. 17219; p. 332).

In the last cited case the Circuit Court held (p. 334):

> "Any covenant between them and him (patentee and licensee) that they will not manufacture certain articles, may be valid as between the parties, *but it does not run with the rubber, like a covenant on land.*
>
> *If his licensees do not perform their agreements, his remedy is by action against them on his covenants, and not by recourse to a chancellor to restrain third persons who have purchased vulcanized rubber from his licensees from using it, when it is theirs, for any purpose they please.*" (Matter in parenthesis ours.)

ummary.

It is submitted that it is an inescapable conclusion in ew of the uniform trend of the decisions of this Court ereinabove analyzed, as well as the express holdings there- , that the attempted restriction on petitioner's use of the nplifiers it purchased from respondents' licensee, Ameri- n Transformer Company, is invalid and unenforceable, d that petitioner, in so purchasing the said amplifiers om a manufacturer duly licensed under the patents in suit make and sell them, acquired the right to use the ampli- ers for any purpose within their capability of use, free om any further monopoly of the patents under which ey were made and sold. In consequence, and regardless all other phases of this case, petitioner has not infringed e patents in suit.

POINT III.

The acceptance and retention by respondents' authorized agent, until long after the suit was instituted, of the royalties paid by the licensed manufacturer of the alleged infringing device, is a bar under the principles of ratification and estoppel, to the maintenance of the suit.

The bill in this case was filed in September, 1929, and issue was joined in August, 1931 (Vol. I, fols. 42; 1578).

From February in 1929 until July of 1931 (one month before the expiration by its terms of the license to make and sell which Radio Corporation of America, and respondent patent owner had granted to the American Transformer Co.), the licensee sold to petitioner hundreds of the amplifiers in suit, for full consideration, and paid the fixed royalties thereon to Radio Corporation of America, in its managerial representation of respondents (Vol. I, p. 474, fols. 1420-1421; Vol. III, pp. 1568-1614).

Pursuant to the terms of this license agreement (Deft's. Exh. E, Vol. III, pp. 1414-1423), all sales made thereunder were required to be reported quarterly to the Radio Corporation of America as co-licensor, and access was agreed to be given to the licensors during all business hours to inspect the books of account of the licensee (fols. 4250-4253).

From February to October of 1929 respondents must therefore clearly be deemed to have had knowledge of the sales of the amplifiers to petitioner, and of the royalties regularly paid thereon by the licensee, even though the quarterly reports to the Radio Corporation of America setting forth the number of amplifiers sold were not required

to and did not set forth the names of the purchasers. However, commencing with December 7th, 1929, and running through to July of 1931, the quarterly reports of the licensee showed each sale made to petitioner, the purchase price paid thereon and the royalties therefor transmitted to the licensors (Vol. III, pp. 1568-1614).

Nevertheless, despite the foregoing detailed reports of sales to petitioner, no offer to refund the royalties was ever made until December 18th, 1930, *more than one year after the commencement of this suit* (Vol. II, p. 1216). Moreover, and beyond December, 1930, continuing into July of 1931, sales of the amplifiers in question were continued to be made freely to petitioner, by the licensee with full knowledge by all the parties of petitioner's use and without any protest by respondents (Vol. I, p. 468, Vol. III, pp. 1594-1614). Nor was the licensee ever sued for alleged violation of its license in selling to the petitioner or was its license ever cancelled (Vol. I, pp. 344, 349).

The District Court, in the case at bar, seemed to have been of the opinion that these facts with respect to receipt of royalties after suit commenced, would make out a good case for supplemental pleading (Vol. III, pp. 1645-1646, fols. 4935-4936). The Court of Appeals held that the receipt of royalties from the licensee after suit had been commenced would not bar the patentee from prosecuting the action (Vol. III, pp. 1724-1725).

The conclusion is inescapable, however, that respondents' conduct was not of that nature or quality that should appeal to a court of equity and that by such retention of royalties respondents should be barred from obtaining any relief under their bill (*Dickerson* v. *Colgrove*, 100 U. S. 578, 580-81).

This case, moreover, comes squarely within *Brant* v. *Virginia Coal & Iron Co.*, 93 U. S. 326, where this Court held (p. 336):

> "There are undoubtedly cases where a party may be concluded from asserting his original rights to property in consequence of his acts or conduct, in which the presence of fraud, actual or constructive, is wanting; *as * * * where one has received the fruits of a transaction he is not permitted to deny its validity whilst retaining its benefits.*"

Legal preclusion by acceptance of benefits is not dependent on the ordinary principles of estoppel alone. There need be no reliance upon the acts of the party who accepts the benefits. There need be no inferring of consent or actual consent. Acceptance of benefits, is, in reality, ratification, the equivalent of an express contract. The right of petitioner here to invoke that principle arises simply because respondents and their co-licensor the Radio Corporation of America have deliberately and knowingly received the benefits of the transaction arising out of the sale of the amplifiers to petitioner by accepting and retaining for more than a year after suit the royalties paid by their licensee on those sales to petitioner. And, it need hardly be said, a return of the royalties to the licensee after the expiration of that long interval cannot wipe the slate clean.

In *Wilson* v. *Union Electric Light & Power Co.*, 59 Fed. (2d) 580 (C. C. A. 8), it was said that the true principle is that a litigant will not be heard to impugn the validity of a proceeding from which, to a substantial degree, he has voluntarily accepted the benefits, no matter in what stage of maturity the proceeding may be. This was said with reference to a judicial proceeding.

The Court, in *Hector* v. *Mann*, 225 Mo. 228; 124 S. W. 1109, speaking to the point, said (p. 247):

> "In no case we can find, breaking on the exact point, was any stress laid upon the fact that the party invoking this particular form of estoppel, need know at the outset of the act of affirmance or change his position on the strength of it in order to make it effective as a defense."

Summary.

It is submitted that respondents' conduct as hereinabove outlined is not at all such as to commend it to a court of equity. The retention of royalties for so long a time after suit was brought, with full knowledge during that entire period of the use to which petitioners put the amplifiers; the failure of respondents ever to protest against the sales of those amplifiers; permitting the license to run its full term without suit against the licensee for an alleged breach and without even a threat of cancellation:—all this must lead to the conclusion that by their deliberate acts respondents must be deemed to have acquiesced in and to have ratified the acts complained of and to have waived any claim of infringement based thereon.

POINT IV.

An inventor who has filed an application for patent showing and describing, but not claiming, certain inventions cannot obtain a valid patent for said inventions by voluntarily filing a "divisional" or "continuation" application for said unclaimed inventions more than two years subsequent to public use of the said unclaimed inventions by him or his assignee or licensee.

This matter is based upon the fact that it has been indisputably proven by the respondents' own witnesses that the

transcontinental telephone lines, employing the inventions of all of the patents in suit, were opened to commercial traffic by the public in January, 1915, with much public acclaim and attention thereto, and have been continuously used since that time in public commercial operations with all of the said inventions (Rec. p. 95, beginning at fol. 285, to Rec. p. 104, inclusive. Note particularly fols. 285, 287, 302, 303, 304, 305, and 312.) Thus, respondents' witness Kendall, one of the engineers of the Telephone Company who was personally familiar with the initial installation, the equipment, and the operation of the transcontinental line, said (Rec. p. 102, fol. 305):

> "I am familiar, in general, with the subject matter of the eight patents in suit. I know, in a general way, what the invention is of each of these patents. *I think that the subject matter of each of these patents has been used by the Telephone Company in its telephone lines commercially since at least as early as September, 1915.* And, I think, they have been used continuously since that time. They have been used in the ordinary commercial business of the Telephone Company in transmitting messages for pay between the distant stations since September 1915."

However, the four Arnold patents issued on applications filed more than two years subsequent to this commercial use, and, in consequence, Section 4886 R. S. constitutes a statutory bar to their validity. Respondents have offered no evidence to form a basis of any explanation or excuse for filing the applications more than two years after their commercial use of the inventions.

The patents to which this defense is applicable are as follows:

1. Arnold Patent 1,329,283.

This patent issued on January 27, 1920, on an application filed July 30, 1918—*three years and six months after respondents' commercial use.*

The invention claimed by the claims in suit (claims 7, 10 and 13) are directed to so spacing the internal electrodes of the tube that the internal impedance of the tube is of the same order as that of the output circuit to which the tube is connected.

The patent purports to be a "continuation in part" of two earlier applications (Serial No. 841,567 and 841,568, both filed on May 28, 1914). Concededly, only the second of these two applications is pertinent to our inquiry. That application matured as patent 1,129,942 on March 2, 1915, and its file history is reproduced in Volume II of the record, beginning at page 1103. On its face, therefore, the patent in suit purports to be for subject matter disclosed "in part" in a patent which was issued in March, 1915, *but the application for the patent in suit was not applied for until July 30, 1918—more than three years thereafter.*

2. Arnold Patent 1,403,475.

This patent issued on January 17, 1922, on an application filed November 11, 1920—*five years and ten months subsequent to respondents' commercial use.*

Claims 8, 9 and 10 of this patent are here involved. In simple language, the invention claimed thereby consists of connecting the input electrodes of an audion across the terminals of a resistance to which the signal current to be passed through the audion is to be supplied, and including a condenser in the shunt connection thus made.

This patent resulted from a division of application Serial No. 48,873, filed on September 3, 1915. The original

application has since matured as patent 1,504,537, which was declared to be invalid in *Western Electric* v. *Wallerstein*, 51 Fed. (2d) 529 C. C. A.

The file history of the original application is reproduced in Volume II of the record, beginning at page 991.

3. Arnold Patent 1,448,550.

This patent issued on March 13, 1923, on an application filed February 3, 1919—*four years and one month subsequent to respondents' commercial use.*

The claims in suit of this patent (claims 1 and 12) are directed to the combination of a three-electrode audion, an inductive coil conductively connected to the input electrodes of the audion, with a conductive impedance in shunt to the coil.

The patent purports to be "a continuation in part" of an application Serial No. 59,210, filed November 2, 1915 (the file history of which will be found in Volume II of the record, beginning at page 1120), and of application Serial No. 48,873 (viz., the same original application which resulted in patent 1,504,537, which, as above noted, was invalidated in the *Wallerstein* case, *supra*).

4. Arnold Patent 1,465,332.

This patent issued on April 21, 1923, on an application filed August 28, 1920—*five years and seven months subsequent to respondents' commercial use.*

Claims 1, 3, 5, 8, 10 and 11 of the patent are here in suit, and the invention claimed thereby may be summed up as the utilization of a common source of current to serve as the "B" or plate current supply for two or more audion tubes.

This patent, likewise, had its origin in the original application Serial No. 48,873, which matured into patent 1,504,537 which was invalidated in the *Wallerstein* case. However, there was an intervening divisional application, namely, Serial No. 285,857, filed March 28, 1919, *four years subsequent to respondents' commercial use;* and which intervening divisional application matured into patent 1,520,994, involved in this suit, and which was held by the Courts below to be invalid. The file wrapper of the intervening application is reproduced in Volume II of the record, beginning on page 961. For the purpose of our consideration, we can ignore the intervening application because it was filed more than two years subsequent to respondents' commercial use. Unless the subject matter claimed by the patent in suit was claimed in the original application (Serial No. 48,873) respondents commercial use more than two years prior to the application for the patent in suit inevitably constitutes a statutory bar to its validity.

Summary and the Law.

We have given, in connection with each of the Arnold patents, the page reference in Volume II of the record where the file history of the original applications from which the applications for the patents in suit were divided or of which they purport to be a "continuation in part". We have also given a brief synopsis of the subject matter of the claims in suit of the respective patents under consideration. Based thereon, we assert without fear of successful contradiction:

(a) In no original or parent application was there claim made to the subject matter forming the claims of any of the patents in suit.

(b) In no instance was there a requirement by the Patent Office to file any divisional, supplemental or continuing application. In other words, the filing of the application for each patent in suit as a "divisional" application or as a "continuation" was the voluntary act of the patentee, and was not predicated on any invention claimed in the original case from which it purports to be either a division or a continuation.

(c) All of the claims contained in the parent or original applications which were cancelled by the applicant during their prosecution were so cancelled, because of their rejection by the Patent Office on the merits of their subject matter, without reservation of any kind or nature whatsoever on the part of the applicant.

(d) Three of the four above enumerated patents in suit involved in this defense (Nos. 1,403,475, 1,448,550, and 1,465,332) had their origin in an original application which matured in patent 1,504,537, which was held to be invalid in the *Wallerstein* case.

On the foregoing facts, it is quite obvious that all four of the Arnold patents in suit are invalid because they were issued on applications which were filed more than two years subsequent to the admitted public and commercial use by respondents.

Chapman v. *Wintroath*, 252 U. S. 126; *Webster Electric* v. *Splitdorf*, 264 U. S. 463; *Westinghouse Electric* v. *Jeffrey-DeWitt Insulator Co.*, 22 Fed. (2) 277 C. C. A. 2nd; *Otis Elevator Co.* v. *Atlantic Elevator Co.*, 47 Fed. (2) 545, C. C. A. 2nd; *Crown Cork & Seal Co.* v. *Ferdinand Gutmann*, 86 Fed. (2) 698, C. C. A. 2nd.

Under Section 4886 of the Revised Statutes,* a valid patent may issue to an inventor only if the claimed invention was:

> "not in public use or on sale in this country for more than two years prior to his application * * *."

We are not here concerned with whether or not the term "his application" refers to the *parent* application or to a divisional application, because it obviously refers to the application for patent *for the invention in question,* and it has at no time been disputed by respondents that the first time claim was made for the inventions forming the subject matter of the patents in suit was when the alleged "divisional" or "continuation" applications were filed.

The language of the statute is clear and unambiguous, and it expressly precludes the validity of patent claims made more than two years subsequent to "public use" or "sale" of the claimed invention. Obviously, therefore, if the claim as contained in the patent as issued, was, as undisputedly is the case here first made in an application for patent filed more than two years subsequent to the public use of the invention as claimed, the patent was improvidently granted and is invalid under the statute regardless of whether it be called a "divisional" or "continuation" patent, or by some other arbitrary or fanciful name.

This has been specifically held in *Westinghouse Elec. & Mfg. Co.* v. *Jeffrey-DeWitt Insulator Co., supra.* In that case the Court said (at p. 279):

> "Moreover, there is a statutory bar (section 4886, Rev. Stat. [35 U. S. C. A. Para. 31; Comp. St. Para. 9430]) which prevents the appellant from succeeding, for there was a sale of the invention more

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* Reproduced in full, Appendix, p. 70.

than two years prior to the filing of the application upon which the patent was granted. This invalidates the patent. The patent being a division of an earlier parent patent, the courts have held that in the absence of laches, or estoppel of intervening rights, the rights under a divisional patent relate back to the date of the filing of the original application, and are in no way affected by an intervening bar; this, upon the theory that there could be no estoppel short of actual proof of abandonment. But recent cases in the Supreme Court have modified that rule. Chapman v. Wintroath, 252 U. S. 126, 40 S. Ct. 234, 64 L. Ed. 491, and Webster Electric Co. v. Splitdorf Co., 264 U. S. 463, 44 S. Ct. 342, 68 L. Ed. 792. * * *

Since it has been clearly established that the sale was made two years prior to the filing of the divisional application, and no excuse given for such delay, the patent must be held to be invalid by reason of section 4886 of the Revised Statutes."

Of course, there is no distinction, under the statute, between a prior "sale", considered by the Court in the foregoing case, and a prior "public use" in the case at bar.

In *Webster Electric Co.* v. *Splitdorf*, referred to in the above decision, this Court, after discussing its previous decision in *Chapman* v. *Winthroath* (likewise referred to), said:

"Our conclusion, therefore, is that in cases involving laches, equitable estoppel or intervening private or public rights, *the two-year time limit prima facie applies to divisional applications*, and can only be avoided by proof of special circumstances justifying a longer delay. In other words, we follow in that respect the analogy furnished by the patent reissue cases" (p. 471).

We particularly call attention to the fact that in the *Webster* case this Court specifically included "public"

rights and "private" rights. This becomes a matter of importance in view of the fact that in several instances since that decision attempt has been made to differentiate from the *Westinghouse* case by limiting the availability of the statutory bar to one who has "private" rights of an intervening nature. Not only is such attempted differentiation contrary to the plain purport of the language in the *Westinghouse* case and the express language of this Court in the *Webster* case, but any doubts that may remain with respect thereto have been swept aside by the more recent decision of the Court of Appeals in *Otis Elevator Co.* v. *Atlantic Elevator Co.*, 47 Fed. (2d) 545, at page 550, to the effect that:

> "an infringer may vicariously avail himself of *any* intervening rights",

and that:

> "when the time has been longer, (than two years) it is not necessary in order to avail of intervening rights that they should be those of the infringer." (Matter in parenthesis ours.)

This case was one involving a reissue patent, as distinguished from a divisional application, but the decision of this Court in the *Webster* case expressly settled (as quoted above) that the same principle of laches, equitable estoppel, intervening private or public rights, such as are present in the application of the reissue statute, "applies to divisional applications" as well.

The most recent decision on this subject is that of the Second Circuit Court of Appeals in *Crown Cork & Seal Co.* v. *Ferdinand Gutmann & Co.*, 86 Fed. (2d) 698 (here on certiorari), wherein the Court said (p. 702):

> "As we have previously shown, Warth's patents Nos. 1,788,260 and Reissue 19,117 contained no claims

broad enough to cover pre-heating. Hence there was no claim for the pre-heating method on file in the Patent Office from December 3, 1930, until April 4, 1933, when Warth applied by his second divisional application for the pre-heating patent. The disclosure, however, had been continuously on file since January 7, 1927; and so plaintiff contends that it is entitled to that filing date. We do not so understand the law as laid down in *Webster* v. *Splitdorf*, 264 U. S. 463, 471; 44 S. Ct. 342, 344; 68 L. Ed. 792."

The facts in the present case are fully analogous to those in the *Crown Cork & Seal* case. An examination of the file histories of the parent or original applications in which each of the patents in suit had their origin reveals that not only was there no claim directed to the subject matter of each of the patents in suit at the time their respective applications were filed, but that no claim had ever been made for that subject matter, either specifically or broadly.

Although, as above pointed out, the Court of Appeals below had held that the provisions of Section 4886 of the Revised Statutes constituted a statutory bar to the validity of a patent issued on a divisional application filed more than two years subsequent to *the use and sale by an alleged infringer* (in the *Westinghouse* case, *supra*), or by *publication by a third party* (in the *Crown Cork & Seal* case, *supra*) it held in the present case that *the statute is not applicable to the patentee, or his assignee or licensee.*

This, we submit, constitutes fundamental error because it is believed to be self-evident that the statute draws no distinction whatever between the patentee or his assignee and any other member of the public. And no distinction in fact or in reason exists. Apparently the Court of Appeals lost sight of the intervening *public rights* to which this Court

specifically referred in the *Webster* case, and petitioner, as a member of the public, was entitled to exercise those rights without hindrance from respondents by means of the obviously invalid patents, the applications for which were deferred, without excuse or explanation, for from three to nearly six years subsequent to the widely publicized commercial use of the inventions claimed thereby.

We are not unmindful of the fact that the Court of Appeals in its opinion (Vol. III, p. 1722) implies, through the medium of a quotation of its decision in the *Crown Cork & Seal* case, that the parent or original Arnold application, throughout the intervening years (between the public use of the inventions, and the divisional or continuation applications for patent therefor) contained "broader claims" the allowance of which was being solicited. Even if this fact were relevant (and we submit it is not) there is no factual support for the inference, *and no assertion to that effect has ever been made by respondents in the Courts below, either in the record, the briefs, or in oral argument.* Indeed, it cannot be made, for as a matter of fact it cannot be supported by the record in this case.

Obviously, therefore, the opinion of the Court of Appeals below in the present case establishes an erroneous precedent, not only wholly inconsistent in attempted differentiation with prior decisions on the same issue by the same Court, but likewise wholly inconsistent with and contrary to the plain purport and intent of the statute involved.

On this phase of the case, therefore, the Court of Appeals below should be reversed, and the four Arnold patents in suit declared invalid.

POINT V.

Each of the patents in suit is invalid because of complete anticipation by or want of invention over the prior patented art.

Under this heading each of the six patents with which this appeal is involved will be treated separately.

Arnold Patent No. 1,329,283 (Vol. II, p. 626).

The patent is identified as the so-called "power circuit" patent. Claims 7, 10 and 13 are here relied upon.

The object of the invention, as stated by the patent, is

> "to provide a structure by which certain desired characteristics of the amplifier may be secured at will and in an efficient manner" (p. 1, line 12).

How this object is attained is next stated in the following language:

> "This object is accomplished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in the specification."

In essence, the ensuing explanation may be summed up in the statement that by changing the geometry of the tube, *e. g.*, the spacial relation between the plate and grid electrodes, different electrical characteristics result.

Referring to claim 7 specifically, the invention is stated to be in combination with an ordinary audion tube having cathode (filament), anode (plate) and control (grid) elements, an input circuit (connected between the grid and

filament electrodes) and an outgoing circuit having impedance and connected to the anode and cathode—

> "said cathode, anode, and control element being so spaced that the impedance of said discharge device (audion) between said anode and said cathode is of the same order as that of said outgoing circuit".

In other words, the essence of the claim is to match the impedance of the plate-filament or output circuit with the internal impedance of the tube so as to have them at the same, or at substantially the same, value.

Claim 10 brings into the combination a still further geometrical limitation, namely, that the grid is made of "coarse mesh". Claim 15 differs from claim 7 merely in defining the output (plate-filament) circuit of the tube as a "work" circuit.

From the foregoing it will be seen, therefore, that, simply stated, this patent is directed to matching the internal impedance of the tube with the impedance in the plate circuit external thereto, and that this is done by varying the *geometry* of the tube in such particulars as spacial relation of the electrodes, and the size or material of which they are made, etc.

First addressing ourselves to the question of whether or not any invention is disclosed in the patent, the desirability, if not the absolute necessity, of matching the impedance in telephone lines, and particularly of matching the internal impedance of an amplifier with the impedance of the output circuit therefrom, has been recognized since the earliest days of electrical communication. Likewise, it has always been known that the impedance of any instrumentality varies according to its geometrical construction (see for example Pierce's testimony, R. pp. 595, 596). In the

earliest days of radio telephony it was recognized that the impedance (in this instance resistance) of the microphone should be equal to the impedance of the rest of the system (see Seibt No. 1,012,456—Vol. III, p. 1438). However, aside from any question of whether or not invention was involved in merely applying this knowledge to a new *type* of device, viz.: an audion tube, Arnold made a full disclosure of the invention in his prior patent No. 1,129,943 (Rec. p. 1459), which he issued on March 2, 1915. What he disclosed in that patent and did not claim he abandoned, and he cannot reclaim what he has abandoned by an application for patent filed, as was the present one, on July 30, 1918, *more than three years subsequent to the issuance of his earlier patent.*

Moreover, Arnold was not the first one to even suggest applying the well known law of matched impedances to an audion or vacuum tube device. Colpitts, one of Arnold's associates, made a full disclosure in his patent No. 1,129,959 of March 2, 1915 (application filed April 6, 1914—Rec. p. 1463). Colpitts stated in his specification (p. 1, line 19):

> "A well known law of electric circuits requires that the impedance of the external path in the circuit should be equal to the impedance of the internal path or source whenever the maximum of available energy is desired,"

and he proceeded to describe in his specification just how that was to be effected in a vacuum tube device.

Likewise, Langmuir of the General Electric Company in his patent No. 1,558,436, granted October 20, 1925, on an application filed October 16, 1913 (Rec. p. 1550), pointed out (p. 3, line 8 *et seq.*) that the geometric proportions of the audion tube affected the amount of current which will pass with a given voltage. (This patent, known as the high vacuum tube patent, because of its early date, was repre-

sented to be a "pioneer" in the art, and was held by the Supreme Court to be invalid for anticipation, want of invention, prior invention, and prior public use in *De Forest Radio Co.* v. *General Electric Co.*, 283 U. S. 664.)

Thus it will be seen that the most that can be said for the Arnold patent is that it endeavored to cover the application to an audion amplifier (as distinguished from other amplifiers theretofore used) of the well known law of matched impedances in amplifying circuits, when the desirability or absolute necessity thereof had always existed, been recognized, and been availed of. Arnold was not the first to do this. He had been preceded by Colpitts, and Arnold himself had made a complete disclosure of the invention which was published in the form of a patent more than two years prior to his application for the patent in suit. Obviously, therefore, the patent is invalid.

Arnold Patent No. 1,403,475 (Vol. II, p. 635).

The patent is identified as the "resistance-capacity coupling" patent. Only claims 8, 9 and 10 are involved in this suit. These claims are directed to a combination comprising: (1) a resistance; (2) means for producing potential variations across the resistance (the incoming signal current derived from a preceding audion, for example); (3) a vacuum tube having input electrodes (grid and filament); (4) connections for impressing the variations on the electrodes (the grid and filament electrodes of the audion are connected to the terminals of the resistance) and (5) said connections comprising a series condenser.

In simple language, therefore, the claimed invention of this patent consists of connecting the input electrodes of an audion across the terminals of a resistance to which the signal current to be passed through the audion is supplied, and including a condenser in the connection.

The other two claims, in varying language, are both directed to this same thought.

Here, again, the claimed invention of the patent is disclosed in a prior patent to the same inventor, viz., Arnold Patent No. 1,129,942 (Rec. p. 1453), which issued (March 2, 1915) prior to the application for the patent in suit (Nov. 11, 1920) as well as prior to the original application (on September 3, 1915) from which the present patent was divided.

Referring to Fig. 6 of the prior Arnold patent, it will be seen that each of the first two audion tubes 1 is connected to its succeeding audion tube by means of a resistance capacity couple. The resistance elements are designated as 17 and 14 and the capacity connected in the lead to the grid electrode of the succeeding tube constitutes the condensers designated by the reference numerals 18. Fig. 7 of this patent discloses the resistance couple between the vacuum tube without the capacity element.

Similarly, Nichols Patent No. 1,257,381 (Rec. p. 1491) shows, in Fig. 3, two instances of a resistance capacity couple between audion tubes. In the lower portion of the figure the coupling is between the vacuum tubes 23 and 30. The resistance element is indicated at 31, and the capacity element at 36. In the middle of the figure the same type of coupling, with the same elements, similarly designated, is likewise shown. It will be noted that the Nichols patent issued more than two years prior to the application date (November 11, 1920) of the divisional application for the patent in suit.

It is thus apparent that the claims in issue of this Arnold patent are wholly invalid for abandonment and complete anticipation.

Arnold Patent No. 1,448,550 (Vol. II, p. 640).

The patent is designated as the "definite input impedance" patent. Claims 1 and 12 are involved. The earliest effective date for the patent is that of its filing, viz.: February 3, 1919. This is so because respondents have made no effort to establish what part, if any, of the subject-matter of the particular claims in suit constitutes a "continuation" of the earlier filed and abandoned applications. Claim 1 of the patent recites the combination of the following elements:

(1) a three-electrode audion;

(2) an inductive coil conductively connected to the input electrodes thereof (grid-filament); and

(3) a conductive impedance in shunt to the coil.

Referring to the single figure of the drawings, this merely means that to satisfy the claim an inductance coil 5 is connected between the grid and filament electrodes, which inductance coil is shunted or has connected therearound a conductive impedance (such as a resistance) designated by reference character 6.

Claim 12 merely attempts to define the magnitude of the impedance, which is specified as "of the order of 500,000 ohms".

On the question of validity of this patent we first direct attention to Colpitts Reissue Patent No. 14,380 (Rec. p. 1486), the disclosure of which is identical with that of its original patent which issued on April 27, 1915, on an application filed May 18, 1914.

Referring to either figures 2 or 3, the input (grid-filament) circuit of the audion tube 1 contains the inductance 4 which is shunted by the resistance 36 which may either be fixed as to value, as shown in Fig. 3, or variable, as shown

in Fig. 2. Of course, as is made apparent by the disclosure of the Arnold patent in suit, a resistance is a conductive impedance. There is thus complete anticipation of the alleged invention of claim 1, as well as of any patentable subject-matter in claim 12.

We also call attention to the complete disclosure of the subject of input impedances and their control in the Colpitts Patent No. 1,129,959, granted March 2, 1915—(Rec. p. 1463). The input impedance of this patent is stated to be "high" (p. 2, line 76; see, also, Waterman XQ, R. 197, fol. 590).

We likewise direct attention to the Van Der Bijl Patent No. 1,350,752—(Rec. p. 1507), which issued on an application filed August 21, 1915, and in which the precise arrangement of the subject-matter of claim 1 of the Arnold patent is illustrated by the transformer 17 shunted by the conductive impedance 10 connected across the input (grid-filament) circuit of the audion tube 2, Fig. 4.

From the foregoing it will be seen that here, again, claim 1 of this Arnold patent is invalid because of complete anticipation, and that claim 12 thereof is devoid of patentable novelty as merely being for specific electrical values, any choice of which being exhausted by the teaching of the prior art that the shunted impedance may be varied to any desired value.

Arnold Patent No. 1,465,332 (Vol. II, p. 643).

The patent is designated as the "common plate supply" patent. Claims 1, 3, 5, 8, 10 and 11 are involved. The patent issued on August 21, 1923, on an application filed August 28, 1920. It purported to constitute a division of a divisional application, which in turn was based on an original application filed September 3, 1915. As the name given to

it implies, the asserted invention of this patent, and of the particular claims involved, consists of utilizing a common source of current supply for the plate or output circuit of a number of audion tubes.

Whenever a single source of current is utilized to supply the plate electrodes of a number of audion tubes in a system, it is obvious that there is bound to be a portion of the circuit which is common to all of the tubes. The existence of this common portion of circuit is apt to cause interaction between the various tubes so that an effect or influence in the circuit of one tube will be transmitted to the other tubes. To avoid this interactive effect it has been customary in the electrical art, specifically including the vacuum tube art, to employ what are termed "filters" inserted between the common portion of the circuit and the remainder of the circuits it is desired to partially isolate therefrom. A filter consists of nothing more or less than inductance and capacity.

What the patent purports to cover is, as its name indicates, a common plate current supply, with the usual filters between it and the respective audion tubes of the system. For example in claim 8, which may be taken as illustrative, interaction between the tubes due to the common source of plate current supply is prevented by "bridging a capacity" (connecting a condenser) "across each of the circuits connecting said tubes to said source". Another illustrative expression is that contained in claim 11 wherein the invention claimed is stated to be the provision of "filter connections between successive amplifiers of the system".

With the invention of the patent thus simply stated, it will be apparent from an examination of the pertinent art prior to the date of the patent that the claims are invalid.

The utilization of a common source of current for supplying the plate electrodes of any desired number of tubes,

as well as the utilization of filters to prevent interaction between the various tubes by reason of the common plate source supply, was known and used many years prior to the date of the patent in suit.

Reference is first made to Arnold Patent No. 1,129,942 (Rec. p. 1453) which it will be noted issued on March 2, 1915, prior to the filing date of the application for the patent in suit (August 28, 1920), as well as prior to the original application for patent (September 3, 1915) from which the patent in suit was divided. Reference to Figs. 5, 6 and 7, and the description thereof contained on page 3, lines 18 to 44 of the prior patent makes it perfectly apparent that the claimed invention of each of the claims of the patent in suit is there shown. The common source of current for the plate circuit of each of the vacuum tubes is that illustrated at 13. With reference thereto the specification states "a common battery serves for all of the plates" (p. 3, line 23). It will likewise be seen, for example Fig. 6, that there is provided an inductance 17 and condensers 18 in the connection between each of the plate electrodes and the filament thereof. This inductance and condenser in each instance is the same as the inductance 21 and condenser 23 of the patent in suit, and constitutes the "filter". Obviously, therefore, there is complete identity between the disclosure of the earlier Arnold patent and the claimed invention of the Arnold patent now under consideration.

This Arnold patent is, therefore, invalid because of complete anticipation.

Mathes Patent No. 1,426,754 (Vol. II, p. 619).

Claim 8 of this patent is the only one here involved.

This patent was involved in the *Wallerstein* case (60 Fed. [2d] 723) and was considered by the Court beginning at

page 731. A different claim (No. 25), directed to the same subject-matter, was involved in that suit and was held by the Court to be not infringed, with a direct implication that it was anticipated by a prior patent to Colpitts and Arnold. The Colpitts and Arnold Patent (No. 1,388,450) is here relied upon as a complete anticipation of claim 8, as well as several other patents to which reference will be made.

An examination of claim 8 shows that the invention purported to be covered thereby is, as stated by the Court in describing the disclosure of the patent, the supplying of a negative bias to the grid, input, or control electrode of an audion tube, and this is stated to be effected by employing the instrumentalities enumerated below with reference, for example, to Fig. 1 of the patent.

(1) A source of current 6 connected to the cathode 3;

(2) A resistance 9;

(3) A circuit containing the cathode 3, a source 6, and the resistance 9 in series;

(4) The resistance 9 being also included in the input circuit of the tube (viz.: the circuit which connects the grid electrode 2 with the filament electrode 3 through the inductance and resistance 8, 10, respectively) whereby a potential negative to an amount equal to the potential drop across the resistance 9 is maintained on the grid electrode 2.

In other words, and simply stated, the alleged invention defined by this claim of the Mathes patent consists merely in connecting a resistance between the negative terminal of the source of current, employed for lighting the filament, and the grid electrode so that the grid electrode will be

negative in potential relative to the filament electrode, by an amount equal to the potential drop across the resistance. Precisely this arrangement for exactly this purpose is disclosed in patents prior to Mathes.

Referring to Arnold Patent No. 1,129,942 (Rec. p. 1453), it will be seen (for example in Fig. 6) that the input (grid-filament) circuit of the audion tube 2 may be traced from the grid electrode 7, battery 11, condensers 18, resistance 14, impedance coil 17, battery 13, battery 12, resistance to the filament 9. Thus there is—

(1) a source of current 12 connected to the cathode 9;

(2) a resistance 14;

(3) the circuit containing the cathode 9, the source of current 12, and the resistance 14 is in series; and

(4) the resistance 14 is included in the input (grid-filament) of the tube.

If this circuit connection of the patent produces a negative potential on the grid electrode of the tube it inevitably, inherently and unavoidably will do likewise in the Arnold disclosure; and this is true wholly irrespective of whether or not additional instrumentalities, such as batteries, etc., may be employed to magnify or raise to a greater degree the negative potential applied thereto.

Similarly Fig. 2 of Arnold Patent No. 1,129,943 (Rec. p. 1459) shows an arrangement wherein the input circuit of the audion tube in the middle of the figure consists of that circuit which connects the grid electrode 1 through battery 5, resistance 8, battery 9, battery 7, resistance (unnumbered) to the filament 3 (all of the filaments being connected in series). Thus, here again, the filament lighting battery 7, the resistance 8, and the cathode are connected in series with

the resistance in the input circuit, which arrangement constitutes the invention purported to be claimed by claim 8 of the Mathes patent.

Finally, we direct attention to the Colpitts and Arnold Patent No. 1,388,450 (Rec. p. 1531), referred to by the Court in the *Wallerstein* case. In Fig. 2 the input circuit of the audion tubes 27 and 28 (which are connected in parallel) can be traced from their grid electrodes through the tuned circuit 58, 59, 60, resistance 64, balancing circuit 62, 63, 65, filament heating source of current 61, and filament resistance and filament 33. Thus it will be seen that the current source, the resistance, and the filament are in series, and that the grid electrodes will be maintained negative relative to their filament an amount determined by the drop of potential across the resistance.

It will be apparent, therefore, that claim 8 of the Mathes patent is wholly invalid because of complete anticipation.

Lowenstein Patent No. 1,231,764 (Vol. II, p. 615).

All of the claims of this patent are involved, except claim 3.

The prior art here relied upon is the same as that considered by the District Court in the *Western Electric Co.* v. *Wallerstein* case (51 Fed. [2d] 529), and which led to the conclusion by the District Court that the Lowenstein patent was invalid. This conclusion was reversed by the Court of Appeals below (60 Fed. [2d] 723) *without discussion of the art here presented.*

The Lewenstein patent is directed to applying an electrical potential on the grid electrode of an audion tube. More specifically, the invention consists of applying a *negative* potential on that electrode. An ordinary battery is employed for that purpose. The application of a potential

on the grid electrode of an audion tube—and specifically by means of the identical instrumentality, a battery—preceded Lowenstein by many years and is disclosed in Stone Patent No. 884,110 of 1908—(Rec. p. 1432; the battery is illustrated by reference character Z); and DeForest Patent No. 841,387 of 1907—(Rec. p. 1424, the battery is illustrated at B", Fig. 2).

Stone connected the *positive* terminal of his battery to the grid electrode of the audion tube so that a *positive* bias was applied to that electrode. There are only two possible ways of connecting the battery relative to the grid electrode, one being to connect a *positive* terminal thereto, and the other to connect the *negative* terminal thereto (see testimony of Heising, Rec. p. 116, fols. 347, 348). Therefore, with the advantage of using a biasing battery exhausted by Stone, and one of the only two possible ways of utilizing the battery for biasing purposes likewise exhausted by Stone, what invention remained, we ask, as distinguished from the ordinary expected skill of the man versed in the art, or, stated, another way, as distinguished from ordinary common sense, in using the sole remaining connection? We submit that no invention remained. And this is especially true in view of the fact that the original De Forest patent for the audion tube showed a biasing battery connected to the control electrode thereof (shown as a plate but the equivalent of the grid shaped wire in function and operation) with *no* designation of polarity of the biasing battery, leaving its polarity a matter of choice or desire (see battery B", Fig. 2, De Forest Patent No. 841,387—Rec. p. 1424).

Moreover, there was nothing whatever novel in the idea of maintaining the grid electrode of an audion tube negative relative to its filament at the time of the Lowenstein invention. From the earliest days of the audion art—indeed

since the invention of the audion by Dr. De Forest—the filament of the audion tube was *always* heated from a battery *so connected that its negative terminal would be connected to the grid electrode* (see De Forest Patent No. 879,532—Rec. p. 1428, Figs. 1 and 2; De Forest Patent No. 995,126—Rec. p. 1435, Figs. 1 and 2).

It is submitted, therefore, that the Lowenstein patent is wholly invalid as entirely wanting in patentable novelty.

Summary.

The time has long since past when a valid patent monopoly may be established on trivial, inconsequential changes or modifications over what existed in the prior art. The uniform trend of the decisions of this Court in patent cases —indeed, the express assertion in the opinions of this Court —is that a *substantial* step beyond the prior art must be taken in order to support a valid patent (*Carbice Corp.* v. *American Patents Development Corp.*, 283 U. S. 27; *American Fruit Growers Inc.* v. *Brogdex Co.*, 283 U. S. 1; *Smith* v. *Springdale Amusement Park Ltd.*, 283 U. S. 121). This has been judicially recognized by the Courts of Appeals below (*e. g. Rosenberg et al.* v. *Car Fastener Co.*, 51 Fed. (2) 1014, 1019); and this is specifically true in the radio art (*DeForest Radio Co.* v. *General Electric Co.*, 283 U. S. 664; *Technidyne Corp.* v. *McPhilben-Keator*, 72 Fed. (2) 242, C. C. A.). Those cases have made it quite evident that no longer can the mere changing of circuit connections, or optionally making an electrical constant variable or fixed, or changing the point of insertion of an instrumentality in an electrical circuit, or changing the polarity of a current source (as is the case with all of the patents here in suit) be successfully advanced as a basis for a valid patent.

Respondents' present attempt to appropriate monopolies by the mass of patents in this case, which patents differ from each other neither in substance nor disclosure, insofar as they are here pertinent, but the dates of applications for and issuance of which, spread over a period of many years, certainly does not warrant the approval or sanction of this Court.

The Arnold patents here in suit are obviously invalid because of statutory bar. And all of the patents in suit are invalid because of complete anticipation and want of patentable novelty.

On this phase of the case, therefore, the Court of Appeals should be reversed, and the case remanded to the District Court with instructions to dismiss the bill of complaint because of invalidity of all six of the patents on which the suit is based.

Conclusion.

In conclusion, it is submitted—

1. Petitioner, by its use of amplifiers purchased from a licensee of respondents, licensed to make and sell the amplifiers, did not and could not infringe the patents under which, concededly, the amplifiers were manufactured and sold. Therefore, petitioner is not guilty of infringement as charged in the bill of complaint.

2. The "license notice" attached to the amplifiers sold to petitioner, purporting to restrict the use to which the amplifiers might be put, was neither valid nor enforceable; and petitioner's use of the said amplifiers outside of the attempted restricted use specified in the said "license notice" did not, as a matter of law, make such use an infringement of the patents in suit.

3. Regardless of all patent questions involved in the case, the fact that the amplifiers were sold to petitioner by respondents' licensee under a license agreement between respondents and the said licensee which required royalty payment by the licensee, and the further fact that the royalties were paid by the licensee to respondents for all amplifiers so sold petitioner, which royalties were accepted and retained for a period of more than a year after the commencement of this action, bars respondents, because of acquiescence and estoppel, from maintaining this suit.

4. The four Arnold patents in suit all issued on applications filed more than two years subsequent to widely publicized commercial use of the inventions thereof by respondents, and in which applications the inventions here in controversy were first claimed. In consequence, those patents are wholly invalid under Section 4886 R. S.

5. Each of the six patents in suit is invalid because of complete anticipation by or want of invention over the prior patented art.

In consequence, the decision of the Court of Appeals below was in error, and, upon any one of the foregoing grounds, the Court of Appeals below should be reversed, and the case remanded to the District Court for the Southern District of New York with instructions to dismiss the bill of complaint.

Respectfully submitted,

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APPENDIX.

U. S. Revised Statutes, *Sec. 4884* (U. S. C. Title 35, Sec. 40). Every patent shall contain a short title or description of the invention or discovery, correctly indicating its nature and design, and a grant to the patentee, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the invention or discovery throughout the United States and the Territories thereof, referring to the specification for the particulars thereof. A copy of the specification and drawings shall be annexed to the patent and be a part thereof.

U. S. Revised Statutes, *Sec. 4886* (U. S. C. Title 35, Sec. 31). Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceeding had, obtain a patent therefor.

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IN THE

Supreme Court of the United States

October Term, 1957

No. [redacted]

General Telephone Corporation,
Petitioner,

v.

Western Electric Company, Inc., Automatic Electric Laboratories, Inc., and American Telephone and Telegraph Company,
Respondents.

REPLY BRIEF FOR PETITIONER

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IN THE

Supreme Court of the United States

October Term, 1937

No. 357

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

REPLY BRIEF FOR PETITIONER.

It is asserted by respondents, and repeated throughout their brief, that they are actuated by a desire to benefit the public and to stimulate trade in seeking to enforce "license notice" restrictions against purchasers of articles made and sold under their patents. (Resp. brief, pp. 23-25). Indeed, respondents say that the purpose underlying the formation of the patent pool, commonly known as the "Radio Trust" (Petr. brief, p. 4), was "to make fully available to the public the great benefits of the new art. • • •" (Resp. brief, p. 58).

If this somewhat naïve expression of motive by one of the largest industrial monopolies in the world is to be taken

at face value it would seem difficult to explain (1) why respondents were prosecuted in 1930 under the Anti-Trust laws on this very patent pool and, to obtain a dismissal, were compelled to modify the agreement so as to eliminate the exclusive license feature therein (Vol. I, fols. 1556, 1562-1563; Vol. II, pp. 798-799); and (2) why respondents were adjudged to have violated the Anti-Trust laws in connection with their domination of the talking motion picture industry.[1]

In truth, therefore, if deeds control and not protestations of high motive, respondents' sole purpose in annexing "license notice" restrictions to articles made and sold by their licensees (instead of trying the simple method of contracts with purchasers, of which they were well aware and which they utilized on other occasions [2]), must have been to enlarge the field of their recognized commercial monopoly by obtaining, as they hoped, an additional weapon in the guise of an infringement suit under the patent law. This, indeed, being the real aim of respondents,—so obviously subversive of the public interest,—it is not surprising that their brief endeavors, by subdividing its argument under various sub-titles, to becloud the simple issues here presented and to divert the argument to matters with which this case, a patent infringement suit, is not concerned.

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[1] *Stanley Co. of America, Inc.* v. *American Tel. & Tel. Co., et al; General Talking Pictures* v. *American Tel. & Tel. Co., et al; Duovac Radio Corporation* v. *American Tel. & Tel. Co., et al;* 4 Fed. Supp. 80; on final hearing 18 Fed. Supp. 650. Respondents' assertions with respect to these cases (note 5, p. 60 their brief) are erroneous. On request of their counsel in that litigation the case has now been set for the March Term of the Circuit Court of Appeals for the Third Circuit, and they, as well as the petitioner, are appellants therein.

[2] *Radio Corporation of America* v. *DeForest Radio & Telegraph Co.*, 97 N. J. Eq. 37 (1925); *infra* p. 11.

We refuse to be drawn into argument on irrelevant issues and adhere to the propositions which are advanced in our main brief:[1] (1) Can the owner of a patent, by *an infringement suit under the patent law*,[2] restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade? (2) Can such restriction be effective under the patent law merely by a "license notice" attached to the device sold?

If the answer to either of these questions is—"No"—and that has been the answer of this Court for almost a hundred years—then the "scope" of the license possessed by the manufacturing licensee, to a consideration of which respondents expend their greatest effort, becomes wholly irrelevant to the case. If we read the decisions of this Court correctly, from the standpoint of *infringement*—the remedy here invoked,—once the *power to sell* is given, any such "license notice" restrictions are beyond the pale of the patent monopoly.

Before discussing the merits of the case, we wish to dispose of two preliminary objections raised by respondents (Resp. brief, p. 7).

As to the contention that this Court should not consider Points III and V in petitioner's brief.

Respondents assert that the issues mentioned in Points III and V of petitioner's brief are not in the petition upon which the writ of certiorari was granted, but concede, however, that they do appear in the Specification of Errors

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[1] The issues relating (1) to acquiescence by acceptance of royalties; and (2) to the merits of the patents, are, of course, independent questions and separately treated.

[2] Italics in this brief ours, unless otherwise stated.

therein (Petition, pp. 10-11). We cannot, therefore, understand the basis for respondents' contention that these issues should be here ignored.

Respondents must, of course, concede that the questions involved in these two points were considered and argued at length at the trial and in the Circuit Court of Appeals and are treated at equal length in the opinions of those Courts. Moreover, this Court, in granting the writ in the case at bar, did not limit it to any specific questions.

Apart from the fact that this Court, in any event, must consider the entire record before it on certiorari regardless of whether error was assigned or not (*Story Parchment Co.* v. *Paterson*, 282 U. S. 555), it is also the rule that it will consider all questions raised in the Specification of Errors assigned by petitioner. This Court so held in *Hubbard* v. *Tod*, 171 U. S. 474, 494 (a case relied upon by respondents at page 6 of their brief), and similarly in *Warner* v. *Pier Co.*, 278 U. S. 85, 91; *Olson* v. *U. S.*, 292 U. S. 246, 262; and *Prudence Co.* v. *Fidelity Co.*, 297 U. S. 198, 208.

As to the assertion that Points III and V in petitioner's brief are "essentially questions of fact".

The short and simple answer to this statement is that it is entirely false. In so far as the question of acquiescence and adoption by acceptance of royalties after suit was instituted is concerned, the subject matter of Point III of petitioner's brief, petitioner stands on the documentary record of the case and on entirely uncontroverted testimony. In so far as the merits of the patents are involved, as set forth in Point V of petitioner's brief, there is no disputed question of fact before the Court for consideration.

Replying to Part I of Respondents' Brief on the defense of purchase from a licensee empowered to make and sell.

As to the contention that the sales to petitioner were outside of the license of the American Transformer Company.[1]

Respondents apparently place their main reliance on the assertion that in as much as the American Transformer Company was licensed to manufacture and sell the amplifiers under dispute only for certain specified uses to be set forth on "license notices" attached to the amplifiers upon their sale, that the licensee's sales with knowledge that other uses for the amplifiers were contemplated, made such sales *"in infringement of the patents"* and not *"under the patents."* On this assertion respondents build a most elaborate and extended argument. The want of merit in the contention and in the argument built thereon becomes apparent on but a moment's reflection.

In the first place, it emphasizes the fact that the distinction respondents seek to draw between the two conditions is not made to depend on any act of the licensee. The Transformer Company had the right to sell, and it would exercise that right in both instances in the identical manner and in every respect, viz: by attaching the "license notice" as directed by the agreement. The ultimate determination of whether or not any particular sale would constitute a sale "in infringement of the patents" or a sale "under the patents," as contended by respondents, would depend *not* upon any act of the licensee but solely upon some subsequent act

[1] Respondents' brief, pp. 8-20.

of the *purchaser*. Very clearly the licensee was not required, nor would he be permitted by law, to police the purchaser's place of business in order to see that the purported "license notice" limitation on use was observed. The situation can be made very clear by a simple illustration. Let us assume that someone purchased an amplifier from the Transformer Company and told the Company at that time that it was to be used for radio broadcast reception (one of the alleged licensed uses). According to respondents' arguments, that would have constituted a proper sale "*under* the patents". Obviously, if the purchaser subsequent to his acquisition of the amplifier, proceeded to use it with motion picture equipment, that fact would not in any respect affect or alter the validity of the sale by the Transformer Company. Take the converse. Assume that this individual told the Transformer Company at the time of the purchase that he intended to use the amplifier in connection with motion picture equipment, and nevertheless the Transformer Company made the sale, and the purchaser subsequently did not use the amplifier with motion picture equipment, but, on the contrary, used it exclusively for radio broadcast reception. Under the respondents' argument that likewise would have constituted a legitimate sale "under the patents" because of its subsequent legitimate use.

These illustrations fittingly show, therefore, that the ultimate determination, under respondents' argument, of whether or not the amplifier made and sold by one licensed to do so was within or without the purported restrictions of the "license" was dependent in no respect upon any action of the licensee, but solely upon the use to which the ultimate purchaser put the amplifier thereafter. It is clear, therefore that "knowledge" on the part of the selling licensee has nothing whatever to do with the legal principles here

involved, and, at best, merely represents a mental attitude of no legal consequences. In other words, if the "license notice" were legally effective to bar other uses, the knowledge of the licensee that a purchaser intended not to abide by it would surely not destroy that effectiveness.

As a final illustration we present the third possible situation,—namely, where the purchaser acquires the amplifier from the American Transformer Company without being asked and without stating for what use it was to be put. Here, again, under respondents' argument, the sale would be proper as "under the patents", and here, again, according to respondents, an infringement of the patents could occur only depending upon the particular use to which the amplifier was to be put by the purchaser. This last example conclusively demonstrates that the only obligation assumed by the selling licensee with respect to the restriction on use which respondents here endeavor to foist upon the public, was the attachment of the alleged "license notice" to the amplifier when sold. The licensee performed its contract by affixing that "license notice" and thereby used the very means directed by the patentee to accomplish that result. What we have here said is, moreover, in strict accord with the ordinary rules governing the interpretation of contracts, and license agreements are contracts subject to those rules (*Wetherill* v. *Passaic,* Fed. Cas. #17,465; 6 Fisher 50 (1872).

The practical construction put upon the agreement by the parties accords with the foregoing view. At page 10, note 1 of their brief, respondents quote a letter from their licensee to petitioner in November, 1928, in which the licensee plainly states that: "The only way which we can sell them" (the amplifiers) is by placing the license notice on the machines. At an earlier date, in September, 1927

(Vol. II, fol. 3642), the licensor wrote to the licensee in response to its inquiry with respect to the license notice restrictions that: "The net result of this is that if *anyone buys* a power supply or amplifier unit from you he may use it for a radio receiving set but he cannot use it for an electric phonograph, etc. * * *". This construction of the contract as given to the licensee is a clear indication that the sole concern of the licensor was the use of the article subsequent to its sale.

In this connection it is significant, as bearing on respondents' insincerity, that although the alleged infringement is based on the purported lack of authority of the licensee to make the sales it did make to the petitioner, that authority was never questioned by the patentee in any action either to cancel the Transformer Company's license or for infringement, or for damages for alleged breach of any covenant therein. Indeed, that license was permitted to run to its natural expiration. The Transformer Company was permitted to continue to make sales of the amplifiers to the petitioner long after this suit was instituted, and the royalties paid by the Transformer Company on these sales were retained for over a year after the commencement of this action. For respondents, then, to insinuate, as they do in various portions of the brief, that petitioner "connived" or "conspired" with the Transformer Company in purchasing these amplifiers, with no charge of that character ever having been made either in the pleadings or at the trial or on appeal, and with no finding whatsoever to that effect, is, apart from the inherent impropriety of such implications, an interesting commentary on the methods pursued by respondents in seeking to attain their ends.

Stripped of the verbiage and misinterpretation and misapplication of the authorities, the present effort of respon-

dents consists merely of an attempt to extend control by means of their patents over devices manufactured and sold under their patents after reaching the public in the ordinary channels of trade. The same efforts were made, and the same arguments advanced, time and time again, but only to meet defeat in this Court. We will not unduly extend this reply by renewed consideration of the authorities on this phase of the controversy which are fully discussed in petitioner's brief (pp. 34-39), but cannot pass without observation what must be respondents' deliberate beclouding of the issue by a misstatement of the facts and the law of *Mitchell* v. *Hawley*, 11 Fed. Cas. 883, affirmed 16 Wall. 544, upon which they rely.

Though respondents deal with *Mitchell* v. *Hawley* at pages 16-19, and 29-31 of their brief, they nowhere say, what could have been easily gleaned from a reading of the case, that what Bayley, the licensee, there received was merely the grant of an exclusive *license to make and use* for a specified territory and for the remainder of the original patent term, *with no power of sale whatsoever*. (*Adams* v. *Burke*, 17 Wall. 453; *U. S.* v. *General Electric Co.*, 272 U. S. 476; 48 C. J., Section 408, p. 263.) We look in vain throughout respondents' brief for that simple statement of fact. It is *that* distinction which runs throughout the cases and which respondents for some reason preferred not to observe. As the Circuit Court pointed out in the *Mitchell* case, in construing the contract that Bayley received (11 Fed. Cas. 883, 885):

> "An examination of this contract shows clearly that it was carefully drawn bythe parties to guard against such a result. Nothing can be more evident than the purpose expressed in this instrument to put it out of the *power* of Bayley to give any title to the machines.

> The very act of sale was a violation of the contract and an act of infringement. * * *." (Italics by the Court.)

Clearly, therefore, if Bayley had received the power of sale he would have had powers enjoyed by a territorial assignee. There is no distinction to be drawn in this connection for the determination of the questions here involved between licensees with a power of sale and territorial assignees with a power of sale. They have one thing in common and that is the power of sale. Once that power is present and patented articles are sold thereunder, the purchaser takes free of any restrictions which the patentee may seek to impose under the patent law on patented articles after their sale, the patentee being relegated to the common law either to make or enforce whatever contractual obligations or conditions he may seek to impose on any of the parties to the transaction. That is precisely what this Court pointed out in *Mitchell* v. *Hawley* and it was so understood in its later decisions (*Adams* v. *Burke,* 17 Wall. 453; *Keeler* v. *Standard Folding Bed Co.,* 157 U. S. 659; *U. S.* v. *General Electric,* 272 U. S. 476). Indeed, this Court in the *Keeler* case expressly refused to extend the doctrine of *Mitchell* v. *Hawley* to cover a case where there has been a sale by the patent owner or by one authorized by him to sell.

As to the public policy argument.[1]

Respondents assert that the public interest actually requires the enforcement of "license notice" restrictions on patented articles after their sale as against the purchasers owning those articles in order that "the public may acquire such devices freely" (Resp. brief, p. 24). This apparently

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[1] Respondents' brief, pages 23-25; 57-61.

innocuous statement takes on added significance when it is recalled that respondents, a powerful public utility, operate as well in other fields such as the talking motion picture industry in which they and petitioner are competitors, and that respondents, even during the period of time involved in the case at bar, have twice run afoul of the Anti-Trust laws.[1]

Respondents plead ignorance[2] of how they could accomplish the beneficent purpose of spreading their inventions throughout the country in the form of articles made under their patents, unless it be through the device of such "license notice" restrictions. However, nowhere in their brief do we find any recognition of the fact that there may be an entirely legal way under the common law by which the use of a patented device can be restricted after its sale, and that is, by a contract entered into between the seller—whether it be the patent owner or his licensee—and the purchaser (provided, of course, that such agreement is not otherwise violative of law). Not only was this method of effecting a restriction on use by contract known to respondents, but it was actually adopted and used by them in other instances (*Radio Corporation of America* v. *DeForest Telephone & Telegraph Co.*, 97 N. J. Eq. 37). However, neither respondents nor their associates in the so-called "Radio Trust" wanted to utilize that method in the present instance. To the contrary, they desired to establish a large number of manufacturing licensees from whom they could, and in fact have, collected annually millions of dollars as royalties—a matter of common knowledge. To accomplish this, obviously no impediment of sales was desirable. Free sales in large quantities was the objec-

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[1] *Supra*, page 2.

[2] Respondents' brief, pp. 24; 55; 61.

tive. Conditional sales contracts, therefore, not only would impede the sales of the manufacturing licensees but also would have centered public and Congressional attention on such a vicious monopolistic practice of the "Radio Trust", the legality of the formation of which was anticipated would be, and in fact has been, attacked both by private interests and by the Government.[1] Therefore the effort was made by respondents to attain this result, viz.: a restriction on use on devices duly sold on the open market,—by the illegal method of attempting to extend the patent laws to do so.

Nor can respondents find support in the cases they cite in support of a purported public policy which would favor "license notice" restrictions under the patent law against purchasers of patented articles. The authorities to which they refer deal simply with the relations between licensor and licensee, with no purchaser of a patented article involved, or with cases arising under the general law in actions in equity.

So, in *Bement* v. *National Harrow Co.*, 186 U. S. 70, quoted at pages 25 and 57 of respondents' brief, the Court was concerned simply with an attempt in an ordinary action in equity to enforce covenants entered into in an agreement between a licensor and a licensee relating to certain patents therein mentioned. The case reached this Court on the charge that the contract involved a violation of the Anti-Trust laws and served as one of the precedents in *U. S.* v. *General Electric Co.*, 272 U. S. 476 in which this Court again held that in an action involving the licensor and the licensee alone limitations would be permitted that would have no legal effect if the rights of purchasers of patented articles

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[1] *Radio Corporation* v. *Lord*, 28 Fed. (2) 257, affirming 24 Fed. (2) 565; cert. denied 278 U. S. 648; on final hearing 35 Fed. (2) 962, affirmed in 47 Fed. (2) 606; cert. denied 283 U. S. 847.

had intervened. (See also the dissenting opinion in *Henry* v. *Dick*, 224 U. S. 61.)

In *Fred Waring* v. *WDAS Broadcasting Station, Inc.*, 35 U. S. Patent Quarterly 272 (Resp. brief, p. 61), and in *Waterson* v. *Irving Trust Co.*, 48 Fed. (2) 704 (Resp. brief, p. 63) no questions under the patent law were involved. They were both actions in equity under the general law and dealt simply with what have been occasionally recognized as exceptions to the general rule at common law that servitudes will not run with chattels after their sale. The exceptions in these cases were the protection of the right of privacy on the one hand, and the enforcement of a covenant to work a copyright on the other. Concededly, these cases can have no application to the case at bar which is concerned solely with an attempt to extend the statutory monopoly of a patent beyond the right granted by that statute.

The "general rule" upon which respondents rely.[1]

We suppose it a proper inference from respondents' sub-titles, viz. (1) "the general rule as stated by the authorities"; (2) "decisions applying the rule to restrictions upon the use of the patented device itself"; (3) "decisions of this Court establishing exceptions to the general rule"; (4) "the restriction in the instant case comes under the general rule and is enforceable";—that respondents are referring to some general rule of the patent law permitting restrictions to be enforced against purchasers of patented articles by means of a "license notice" device. There is no such rule; there are no authorities supporting it, nor decisions of this Court establishing exceptions to the rule, nor is the restriction in the instant case within any such supposed general

[1] Respondents' brief, pp. 26-37.

rule. Indeed, respondents have constructed an edifice of unrealities.

Respondents predicate their whole argument as to the existence of this "rule", on *Bement* v. *National Harrow Co.*, 186 U. S. 70, which they quote immediately before entering upon a discussion of the question. As has been hereinabove observed,[1] that case dealt solely with the contract rights and obligations subsisting between licensor and licensee as the immediate parties thereto. The license sustained in the *Bement* case prohibited the licensee from selling at a lower price or on more favorable terms of payment and delivery to the purchasers than was set forth in a schedule attached to the license. These restrictions, of course, applied only as between the licensor and the licensee, and, as this Court said in that case, at page 93 of its opinion:

> "The provision in regard to the price at which the *licensee would sell* the article manufactured under the license was also a proper and reasonable condition. * * * The owner of a patented article can, of course, charge such price as he may choose, and the owner of a patent may assign it, or sell the *right* to manufacture and sell the article patented, upon the condition that the assignee shall charge a certain amount for such article."

The doctrine of this case, as respondents correctly state, was affirmed in *U. S.* v. *General Electric Co.*, 272 U. S. 476, but what this Court in both cases held valid was a restrictive covenant *between the immediate parties to the contract.* Neither case involved the rights of a purchaser, though this Court in its *General Electric* decision, in drawing the distinction between licensor and licensee relations on the one hand, and patentee (or licensee) and purchaser relations

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[1] *Supra*, page 12.

on the other, summarized what it had previously held with respect to the rights of a purchaser of a patented article, in the following language (272 U. S. 476, 489):

> "It is well settled, as already said, that where a patentee makes the patented article and sells it, he can exercise no future control over what the purchaser may wish to do with the article after his purchase. It has passed beyond the scope of the patentee's rights."

This statement by this Court is far removed from the assumed "general rule" asserted by the respondents, nor can they avoid the effect of what this Court has said on the subject by sweeping it aside,—as they attempt in their brief to do—as *obiter dicta* or mere expressions of general opinion.

Respondents can find no added support in their quotation from Robinson on Patents.[1] What the author said in the italicized portion, quoted by respondents, with respect to conditions that may be imposed by the patentee clearly refers to *contractual limitations or conditions.* That text was published in 1890, a few years prior to the decisions of this Court in *Hobbie* v. *Jennison,* 149 U. S. 355 and *Keeler* v. *Standard Folding Bed Co.,* 157 U. S. 659, although, of course, after the decision in *Adams* v. *Burke,* 17 Wall. 453 which had been decided in 1873. In the *Keeler* case this Court, on reviewing its earlier decisions on the subject, pointed out (157 U. S. 659, 666-667):

> "Upon the doctrine of these cases we think it follows that one who buys patented articles of manufacture *from one authorized to sell them* becomes possessed of an absolute property in such articles, unrestricted in time or place. *Whether a patentee may protect*

[1] Respondents' brief, p. 26.

himself and his assignees by special contracts brought home to the purchasers is not a question before us and upon which we express no opinion. It is, however, obvious that such a question would arise as a question of contract, and not as one under the inherent meaning and effect of the patent laws."

We believe this quotation is indeed dispositive of respondents' contention.

(1) Cases relied on by respondents as establishing a "general rule".

Respondents rely upon six cases as purporting to support the general rule as respondents understand it to be, but on analysis it clearly appears that they are neither relevant nor do they state the principles accepted and applied by this Court in the "license notice" cases. To illustrate:

(1) In *Holiday* v. *Mattheson*, 24 Fed. 185[1] where the facts were entirely unlike those in the case at bar, if the general language of the opinion as quoted by respondents "• • • where a license becomes the transfer"—is to be taken to mean that restrictive conditions are good only in actual licenses as distinguished from sales, the statement need not be questioned. However, the Court predicated its views on *Hatch* v. *Adams*, 22 Fed. 434 which was expressly overruled in the *Keeler* case (*supra*). The facts disclose no sale with restrictive conditions attached.

(2) In *Dickerson* v. *Tinling*, 84 Fed. 192[2] all that the Court held in substance was that the sale of articles in the United States under a United States patent cannot be controlled by foreign laws, a ruling based upon the analogous case of *Boesch* v. *Graff*, 133 U. S. 697.

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[1] Respondents' brief, p. 27.
[2] Respondents' brief, p. 27.

(3) *General Electric Co.* v. *Continental Lamp Works*, 280 Fed. 846[1] was concerned simply with a conceded infringement by a manufacturer who had made a gas filled lamp in direct violation of the patents of the General Electric Company but who claimed that the palpable infringement was nullified by his purchase of unpatented bases for the lamps from the patentee.

(4) At this juncture respondents again come forward with *Mitchell* v. *Hawley*, 16 Wall. 544,[2] arguing that the case illustrates the application of the rule to restrictions on use. Again, we reply that if respondents intend to convey by their statement that the case illustrates a limitation on the use of a device imposed upon a purchaser from a licensee who had the power of sale, we repeat that respondents are gravely in error. The facts show no such situation as claimed by respondents.

(5) In *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536,[3] the Court again was concerned merely with a question of license and not one of sale. A written license had been granted to *use* certain machines for a fixed period. The Court restrained the *licensee* from use of the machines after the termination date fixed by the license, a ruling proper under the authority of *Mitchell* v. *Hawley*. The case is therefore not in point. It is interesting to note, however, that the Court there pointed out that the defendant knew that the plaintiff *licensed* but did not *sell*.

(6) In *Skee Ball Co.* v. *Cohen*, 286 Fed. 275,[4] all that can be gathered from the opinion is that the Court had to

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[1] Respondents' brief, pp. 27-28.
[2] Respondents' brief, pp. 29-30.
[3] Respondents' brief, pp. 31, 52-53.
[4] Respondents' brief, pp. 31-32.

deal with an ordinary *license agreement* under the terms of which the licensee was to *use* the device or to license others to use it within a designated territory. If that were so, the decision could have been put squarely on the authority of *Mitchell* v. *Hawley*, or, perhaps, the Court looked upon the transaction as a transfer of a business with a covenant not to engage in the same enterprise within a specific territory. Such a negative covenant, unless "it tends to a monopoly" has been long enforced (*U. S.* v. *Addyston Pipe & Steel Co.*, 85 Fed. 271, 281-282), but has nothing to do with the claimed application of the patent law to restrictions imposed upon the use of patented articles after they have once been sold to the public. The irrelevancy, then, of this case to the one at bar must therefore be quite apparent.

(2) English authorities relied on by respondents.

Respondents' reliance on English cases upholding price fixing and other restrictions,[1] is of no avail in view of the directly contrary decisions of this Court.[2]

There is an obvious divergence between the English and our own Courts in the interpretation they give to the respective though similarly worded patent statutes of the two countries. This difference is alluded to in the opinions of the Justices of the High Court of Australia whose decision was overruled on appeal by the Privy Counsel in England (*National Phonograph Co.* v. *Menck*, 28 R. P. C. 229; the opinion below reported in 7 Comm. L. R. 481).

Apparently the English courts proceeded on the theory of separation of title from use in the case of a purchaser

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[1] Respondents' brief, p. 28.

[2] *Bauer* v. *O'Donnell*, 229 U. S. 1, *Straus* v. *Victor*, 243 U. S. 490, *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8, *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502 (Petitioner's brief, pp. 20-29). See also, dissenting opinion in the *Dick* case, 224 U. S. 1, 68.

of a patented device, a theory adopted in *Henry* v. *Dick*, 224 U. S. 1, by a four to three decision of this Court, but later expressly overruled in the *Motion Picture Patents* case. In that suit, the briefs reveal, that same contention was again made when the case reached this Court, but the argument was completely ignored and swept aside by this Court which affirmed the dismissal of the bill.

In concluding their discussion of these wholly irrelevant authorities, respondents quote at length from the opinion of this Court in *Independent Wireless Telegraph Co.* v. *Radio Corporation of America*, 269 U. S. 459, concededly a decision confined simply to a question of parties. Respondents, however, fail to introduce the quotation as this Court did, with the words: "The case made in the bill was this", —so as to make abundantly clear that what the Court said with reference to the facts of that case was but a paraphrase of the *pleading* and not even a suggestion, express or implied, of this Court's opinion on the subject.

As to respondents' contention that this Court has established "exceptions to the general rule".[1]

We look in vain for any statement by this Court in any of its opinions that it has ever established a rule that restrictions on a patented article will be enforced against the purchaser by an infringement suit under the patent law, or that this Court has ever created any exceptions to this rule. We are literally amazed at the suggestion.

On the contrary this Court, particularly in the *Boston Store* case, reviewed its prior decisions on the subject and

[1] Respondents' brief, pp. 32-37.

concluded with a holding,—not that it had formulated any exceptions to its rules heretofore announced in those cases,—but that there was only one "fundamental ground upon which as we have seen, the decided cases must rest" (246 U. S. 8, 25). That fundamental ground, to quote the language of the Court, was that:

> "* * * a patentee could not use and exhaust the right to sell, as to which a monopoly was given him by the patent law, and yet by conditions and stipulations continue that law in effect so as to make it govern things which by his voluntary act were beyond its scope * * *" (p. 23).

The fundamental ground common to the decided cases, some of which denied the possibility of projecting the monopoly right to sell, and others the possibility of projecting the monopoly right to use, over articles after sale, must be a denial of the right to apply the patent law to objects which by sale have passed beyond its scope. This *common* fundamental ground rising above mere questions of form, cannot be, as respondents contend, either the *particular* ground that price fixing is in itself unlawful, or the *particular* ground that the attempt to monopolize unpatented articles is in itself unlawful. The one thing common to them is that in both, what the patent owner sought to control lay outside of the monopoly. His sole recourse in such event, this Court said in the *Motion Picture Patents* case, is to the method of *special contract* but not to the patent law which permits no restrictions on patented articles after their sale. As this Court there held (243 U. S. 502, 509):

> "The extent to which the use of the patented machine may validly be restricted to specific supplies *or other-*

> *wise* by special contract between the owner of a patent and the purchaser or licensee is a question outside the *patent law* and with it we are not here concerned (*Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659.)"

This Court again had occasion to review the question in *U. S.* v. *General Electric*, 272 U. S. 476, and reiterated what it had said in *Straus* v. *Victor*, 243 U. S. 490, that:

> "These cases really are only instances of the application of the principle of *Adams* v. *Burke*, 17 Wall. 453, 456."

How can it be said that *Bauer* v. *O'Donnell*, *Bobbs-Merrill* v. *Straus*, *Straus* v. *Victor* and *Boston Store* v. *American*, to which this Court referred in the foregoing quotation and in which the attempt was to restrict the resale prices by printed notice or contract, are each and all "only instances of the application of *Adams* v. *Burke*" if, as respondents contend, the principle of *Adams* v. *Burke* was that an *unrestricted* sale, meaning a sale without notice of restriction, and only such a sale, takes the article outside of the monopoly? What principle is there common to all these cases excepting the principle that the sale of a patented article takes it outside the monopoly, and terminates all patent-law relations between the buyer and the seller, whether the sale be without any notice of restrictions (*Adams* v. *Burke*) or with a restricted "license notice" marked on the article sold (*Bobbs-Merrill* v. *Straus*, *Straus* v. *Victor*, *Bauer* v. *O'Donnell*, and the case at bar), or with a restrictive contract, the validity of which depends upon the general law and not upon the patent law (*Boston Store* v. *American*)?

Thus, there emerges firmly out of these Supreme Court cases not an "exception" as respondents contend, but the very simple rule that the sale of a patented article takes it outside of the patent monopoly, and that rule rises above any mere form in which it is attempted to project the patent monopoly beyond the sale.[1]

The vice in respondents' distortion of the meaning of the phrase "subject to which the monopoly no longer applied" which they cull from the *Motion Picture Patents* decision,[2] therefore becomes apparent. For, how can respondents seriously assert that that phrase refers merely to supplies for the patented machine, when the opinion of the Court places its ruling in that quotation on *Bauer* v. *O'Donnell* and *Straus* v. *Victor* which have nothing to do with supplies but merely with the general principle of law enunciated by the Court that patented articles after their sale are not subject to the patent monopoly.

As to respondents' characterizations of the doctrines applied by this Court in the cases relied on by petitioner, as merely "broad language".[3]

Respondents presumably consider that when this Court refused to extend the scope of the patent monopoly to control patented articles after their purchase and sale, it was merely creating "exceptions" to a "general rule". But, as we have hereinabove observed, this Court has never spoken of any such exceptions or ever mentioned any such

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[1] See petitioner's brief, pp. 22-29, for complete discussion of the cases.

[2] Respondents' brief, pp. 46-47.

[3] Respondents' brief, pp. 39-48.

general rule as argued by respondents to exist in the opinions of this Court. We therefore find it difficult to explain respondents' reference to the "broad language" of this Court, unless it be that this alleged "broad language" constitutes a statement of the rule which this Court has applied to cases of the general character of the one at bar and which respondents now find unsuited to their purposes.

The Court of Appeals below suggested that what respondents now call "broad language" was in truth merely "obiter" and "not necessarily controlling". It assigned as a reason that inasmuch as the decisions in *Bauer* v. *O'Donnell*, *Straus* v. *Victor*, *Boston Store* v. *American* and *Motion Picture Patents* v. *Universal* involved attempted restrictions which were bad on grounds of public policy, the holding of this Court in those cases that those restrictions were equally bad under the patent law,—the sole question presented for decision—must have been surplusage. Such reasoning, we have heretofore observed, is erroneous.[1]

As Chief Justice TAFT said in *Richmond Co.* v. *U. S.*, 275 U. S. 331, 340:

> "• • • It does not make a reason given for a conclusion in a case *obiter dictum* that it is only one of two reasons for the same conclusion."

And in *U. S.* v. *Title Insurance and Trust Co.*, 265 U. S. 472, 485-6, it was held:

> "Enough has been said to make it apparent that that case and this are so much alike that what was said and ruled in that should be equally applicable in this. But it is urged that what we have described as ruled there was *obiter dictum*, and should be disregarded,

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[1] Petitioner's brief, pp. 31-34.

because the Court there gave a second ground for its decision which was broad enough to sustain it independently of the first ground. The premise of the contention is right but the conclusion is wrong; for where there are two grounds, upon either of which an appellate court may rest its decision, and it adopts both, 'the ruling on neither is *obiter*, but each is the judgment of the court, and of equal validity with the other' (citing cases)."

As to respondents' erroneous observation with respect to the extra-judicial comment quoted by petitioner.[1]

Respondents, in attempting to minimize the full effect of Professor Williston's comments with respect to the decisions of this Court voiding license notice restrictions on patented articles after their sale,[2] add quotations from other portions of his book relating solely to restrictive covenants affecting land or contracts relating to the sale of a business. Those cases quite obviously have nothing to do either with the type of action or the issues here involved.

Nor can respondents distort the plain meaning of what Professor Williston has said by injudicious use of quotation marks so as to create the utterly false impression that his understanding of the law on the subject is precisely opposite to what the language of his remarks indicates. Those comments by him were, in this instance, not his views, but simply his interpretation of what this Court has held in the *Straus* v. *Victor, Motion Picture Patents, Boston Store* and *Carbice* cases. One of the authorities he cites as illus-

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[1] Respondents' brief, pp. 49-53.
[2] Petitioner's brief, p. 30.

trative of what other Courts have recently stated with respect to their understanding of these decisions is so illuminating and exact a summary that it bears quotation at length. In *Chicago Daily News* v. *Kohler,* 196 N. E. 445, 449-450:

> "While a patentee may limit a license to making and using the patented article, he may sell it, and if he does, the sale places the article beyond his control as patentee. Thus, where a patentee manufactures the patented device and sells it he can exercise no future control over the article in the hands of the purchaser. Boston Store of Chicago v. American Graphophone Co., 246 U. S. 8, 38 S. Ct. 257, 261, 62 L. Ed. 551, Ann. Cas. 1918 C, 447; Keeler v. Standard Folding-Bed Co., 157 U. S., 659, 15 S. Ct. 738, 741, 39 L. Ed. 848; Adams v. Burke, 17 Wall. 453, 21 L. Ed. 700. The United States Supreme Court, in Keeler v. Standard Folding Bed Co., supra, said: 'One who buys patented articles of manufacture from one authorized to sell them becomes possessed of an absolute property in such articles, unrestricted in time or place.' *Federal decisions denying the right of patent owners, in selling patented articles, to reserve control over the resale or use,* do not rest upon any mere question of the form of notice attached to the articles, or the right to control, solely by reference to such notice, but upon *the basic ground that the control of the patent owner over the articles in question ends with the passing of title.* Boston Store of Chicago v. American Graphophone Co., supra. 'By virtue of the patent law' the Court said in the case last cited: 'one who had sold a patented machine and received the price and had thus placed the machine so sold beyond the confines of the patent law, could not by qualifying restrictions as to use keep under the patent monopoly a subject to which the monopoly no longer applied.'"

With respect to petitioner's reference to Professor Chafee.[1]

Respondents, in complaining that our quotation from Professor Chafee's remarks is not extensive enough, omit to say that it represents Professor Chafee's summary of his understanding of the law as laid down by these cases.

It is interesting to note that the author, in commenting upon the "license notice" cases decided by this Court, makes the significant statement (p. 1002) that "In this country the vital distinction is drawn when title to the article passes". As put by this Court in *U. S.* v. *United Shoe Machinery Co.*, 247 U. S. 32, 58, a patentee "cannot grant the title and retain the incidents of it".

Throughout their brief respondents disregard this essential distinction. In their quotations from the opinions of this Court in which reference is made to "unconditional sales" they repeatedly overlook the fact that what was meant was a transaction in which title did not pass.[2] Conditional sales are well known to the law as meaning only those in which title does not pass until the occurrence of a certain event. This Court treats the "license notice" cases before it on the principle that conditions cannot attach to an *absolute* sale but recognized that if the patentee or his licensee so desire they may contract *specially* with respect to any conditions desired to be imposed on purchasers. Such contractual limitations are, however, as this Court has repeatedly held, entirely outside of the scope of the patent law.[3]

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[1] Respondents' brief, p. 52.
[2] Respondents' brief, p. 46, note 1.
[3] *Hobbie* v. *Jennison*, 149 U. S. 355, 363; *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, 661.

As to Part II of respondents' brief on the defense of acquiescence by acceptance of royalties.[1]

Respondents entirely misapprehend the argument advanced by petitioner on this phase of the controversy. They commence with an absurd statement that this defense is without factual basis and proceed to discuss what transpired before the institution of the suit. What they say in that regard concerning the promptness with which the action was started or the assumed lack of knowledge on their part of the sales by their licensee to the petitioner, is not now before this Court. We are not here concerned with any such controversy or with any such facts. The simple question on the uncontroverted documentary evidence[2] now is whether, by accepting and retaining royalties on the sales made by their licensee to petitioner, for a period of more than one year *after this suit was commenced*, with conceded full knowledge of the entire transaction, they are barred upon principles of acquiescence, whether it be termed adoption, ratification, waiver or estoppel.

It is interesting to note that at pages 68-69 of respondents' brief it is admitted that they *"knowingly"* retained the royalties *after* the suit was filed. Similar frankness is not in the succeeding statement that the royalties were returned "when they learned that they were such". How respondents can make that assertion in the face of the documentary record which clearly indicates that the royalties were not returned until a year after the action was instituted, is more than we can comprehend. The point is, however, not that respondents returned the royalties after retaining them for more than a year, but that they retained them for more than a year after obtaining them.

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[1] Respondents' brief, pp. 65-70.
[2] Petitioner's brief, pp. 40-43.

Respondents cite *Vulcan* v. *Maytag*, 73 Fed. (2) 136, as their authority for retaining benefits and still remaining immune from the defense of acquiescence. That case, to which petitioner refers at page 10 of its brief, was an action between patentee and licensee and not between a patentee (or licensee) on the one hand and a purchaser on the other. Whatever may have been the contractual rights and obligations between the immediate parties in the *Vulcan* case, certainly it cannot be argued that, as against a third person, the acceptance of royalties on articles purchased by that third person from a manufacturing licensee empowered to make and sell them, still leaves the patentee to proceed against a purchaser as an infringer nevertheless. If the *Vulcan* case is to be understood as holding any such doctrine it is fundamentally wrong.

We submit that the question here is not necessarily whether the purchaser acted in reliance upon the acceptance of royalties by the patentee or its authorized agent, but whether the *fact* of acceptance bars the patentee from asserting any rights under the patents in the case. The Court of Appeals below held (Vol. III, p. 1725) that "the very maintenance of the suit showed defendant that there was no acquiescence on which it could rely". Dismissing the question of reliance, we urge that this remark of the Court below is error in law. To illustrate:—Suppose after the suit, the patentee had written its licensee that it knew of the sales which were being made to petitioner, and approved them in all respects, would not that have the effect of vitiating the suit? If so, would the later destruction of that letter by agreement between the licensee and the patentee in any wise affect the rights of the purchaser, the petitioner herein? It seems clear that the conscious, deliberate acceptance for a long period of time of the royalties which

were due only because of the sales hereunder,—a course of conduct followed by the respondents until the filing of the answer herein,—it tantamount to an express adoption of the transaction and a waiver of any alleged rights claimed to be asserted by respondents. The action in the case at bar, equitable in nature, requires respondents to have acted fairly and properly in their dealings with respect to these royalties. This they surely have not done.

In addition to the authorities already cited in our main brief, we wish to add but the following:

In *Clark* v. *West*, 193 N. Y. 349, 360-61, it was stated:

> "A waiver has been defined to be the intentional relinquishment of a known right. It is voluntary and implies an election to dispense with something of value, or forego some advantage which the party waiving it might at its option have demanded or insisted upon * * *."
>
> "As already said, the doctrine of waiver is to relieve against forfeiture; it requires no consideration for a waiver nor any prejudice or injury to the other party."

And in *Kiernan* v. *Duchess Mutual Ins. Co.*, 150 N. Y. 190, 195, it was held that "A waiver, which if it once exists, can never be revoked * * *."

In 3 *Williston* on Contracts (1936), Section 684 at page 1971 the author states:

> "The law simply does not permit a party in the case supposed to exercise two alternative or inconsistent rights or remedies. Even though he expressly states that he intends to reserve a right, he will, nevertheless, lose if he takes an inconsistent course. Thus, one who *continues to receive benefits* under a contract and assert rights under it after knowledge of a breach which would justify him in refusing to go

> on, cannot subsequently set up this breach as an excuse for this own non-performance even though he asserted from the outset, and consistently, that he proposed to do so * * *."

If respondents resort to the argument that the royalties were received by the Radio Corporation of America, their co-licensor, they cannot escape the consequence of permitting their authorized agent to pursue such a course of conduct. In *National Surety Co.* v. *Jackson County Bank,* 20 Fed. (2) 644, 646, the Court quotes the rule as summarized in 21 R. C. L. 932, as follows:

> "It is an established principle of law that, where a person acts for another, who accepts the fruits of his efforts, the latter must be deemed to have adopted the methods employed, as he may not, even though innocent, receive the benefits and at the same time disclaim responsibility for the measures by which they were acquired. With the benefits of the contract he must accept the responsibilities."

As to Part III of respondents' brief on the defense of statutory bar to the validity of the Arnold patents.

Respondents initially question the applicability of this defense to some of the Arnold patents. This they may not do. The subject was opened in the direct examination of their witness Kendall (Rec. Vol. I, pp. 93 to 95). As pointed out in petitioner's brief (p. 44), he was one of the engineers of the Telephone Company who was personally familiar with the original installation, the equipment, and the operation of the transcontinental line and who testified that the subject matter of *all of the patents* was used in that line publicly and commercially as early as September, 1915, and has been used continuously since then.

As above stated, Kendall was respondents' witness and they are bound by his testimony, and his testimony conclusively establishes the facts beyond dispute by respondents, with the result that the statutory bar to validity applies to *all* of the Arnold patents.

Respondents next assert, in attempted support of the opinion of the Court below, that the divisional applications which matured into the Arnold patents in suit were directed to subject matter which was claimed in broader language in the original applications. But respondents do not support this assertion by specific consideration of any such alleged "broader" claims with respect to the Arnold patents in suit, and in fact cannot do so. It is true that in a footnote to page 75 the statement is made that the "subject matter" of claim 4 of the original application 841,567 (Vol. II, p. 1245) was directed in substance to the particular combinations of the claims in suit of the power circuit patent (1,329,283); but it should be noted that it is not asserted that claim 4 of the original application was for the same invention as are the claims of the Arnold power circuit patent in suit, and such a statement could not have been truthfully made, as a reference to the original claim 4 will plainly show, and as we shall now point out.

Claims 7, 10 and 13 of the patent in suit (Vol. II, p. 632) are directed to an audion tube *in combination with the particular circuits therefor*, but claim 4 of the original application, which is by inference, as distinguished from direct statement, advanced as a "broader" claim, directed to the same invention, is directed and confined to *the physical construction of an audion tube*. Moreover, it should be noted that this claim was canceled by an amendment, dated September 22, 1914 (Vol. II, p. 1250), and the application for the Arnold patent in suit was not applied for until July 30, 1918, more than three years thereafter.

Similarly, with respect to the so-called definite input impedance patent (1,448,550), claims 1 and 12 of this patent are involved which, for the purpose of conclusively establishing the point under consideration, are reproduced at the foot hereof.[1]

The footnote on page 75 of respondents' brief selects claim 6 of the original application 59,210 (reproduced Vol. II, p. 1134) as the "broader" claim in the parent application on which respondents' argument is based. We here reproduce original claim 6 to show the utter want of factual support for the assertion.

> "6. In a thermionic repeater, a vacuum tube, a heated electron emitting cathode, an anode and an auxiliary electrode in said tube, a circuit outside of said tube connecting said cathode and said auxiliary electrode, said circuit containing a source of electromotive force whereby the auxiliary electrode is maintained at a negative potential with respect to the cathode; a circuit connecting said cathode and anode, and a source of direct current included in said latter circuit, the vacuum in said tube being so high that a margin of safety exists between the voltage at which all the electrons capable of being emitted by the filament at the temperature at which the latter is maintained flow to the plate and the voltage at which there is perceptible ionization of the residual gas of said tube."

---

[1] 1. The combination of a vacuum discharge repeater of the three electrode type, an inductive coil conductively connected to the input electrodes of said repeater and a conductive impedance in shunt to said coil.

12. The combination of a line, an amplifier in circuit therewith having an input impedance which is practically infinite, and a hunt between said line and said amplifier having an impedance of the order of 500,000 ohms.

The absurdity, as well as the falsity, of respondents' assertion that the foregoing claim is directed to the same invention as claims 1 and 12 of the definite input impedance patent will at once be apparent.

The entire absence of factual support in these two illustrations selected by respondents undoubtedly constitutes the reason why no similar attempt was made with respect to the other two Arnold patents, with the result that petitioner again asserts, without fear of successful contradiction, that in fact, and as revealed by the record in this case, there was not contained in any of the original applications from which the Arnold patents in suit were divided, any claims, broader or otherwise, directed to the subject matter of the claims of these patents here in suit.

It is undoubtedly because of the fact that counsel for respondents realize that there is no factual basis for their argument on this point that they, early in their argument, assert (Brief, p. 76):

> "We do not consider it at all material whether the inventions were or were not claimed in the original applications."

Of course, the authorities cited and discussed by respondents have no application to the defense here under discussion. Most of these cases relate to interference proceedings where the issue was priority of invention, for which purpose the *disclosure* (in specifications and drawings) of an original application has been accepted to establish a date of conception of the invention or a constructive reduction to practice thereof. In fact this was expressly held in *Milburn Co.* v. *Davis-Bournonville Co.* as noted by respondents in the footnote to page 78 of their brief. But what bearing that fact has to do with the question here under

consideration—namely, the time when claim was first made to a specific invention—we fail to see and respondents fail to point out. Thus, in *Chapman* v. *Wintroath*, in the portion of the opinion cited in italics in respondents' brief (p. 78), it was "priority" of right which was considered by the Court. Likewise in *Smith & Griggs Mfg. Co.* v. *Sprague* the Court merely stated that "for the purposes of this case" the date of application of the divisional application was to be taken as of the parent application, but "the purposes of this case" were not for the determination of when claim for the invention was made, or for the applicability of Section 4886 R. S., because, even giving the divisional application the benefit of the filing date of the original application, it was nevertheless invalid because of more than two years' prior use.

Again, *Godfrey* v. *Eames* has no application to the present situation. That case involves a "continuation" application, as distinguished from a "divisional" application, with which we are here concerned. There is no element of similarity between them.

Likewise, there can be no application to the facts of the present case of any authorities, such as the *American Laundry Machinery* case, referred to and quoted from on page 83 or respondents' brief (see also pp. 84 to 88 inclusive) where claims for the invention were presented with the original application and division was required by the Patent Office under rules which we do not question either as to their legality, legal effect, or propriety. A single patent cannot issue to an inventor for two or more inventions. If, therefore, he files an application for patent in which he discloses and claims two or more separate inventions, the Patent Office *requires* that a *divisional* application be filed. But that situation and those rules have nothing whatever to do

with a situation, such as here presented, where the applicant shows and describes a number of inventions but claims only one of them, and then nearly six years subsequent to the public commercial use of the disclosed inventions, as an afterthought, seeks to file, *on his own initiative*, an alleged "divisional" application, thereby endeavoring to reclaim what has passed into the public domain.

As to Part IV of respondents' brief on the merits of the patents.

No useful purpose would be served by reviewing the arguments on the merits of the patents presented by respondents' brief. It is believed that these arguments have been fairly anticipated and covered in petitioner's brief (pp. 54 to 67). There are two points in connection therewith, however, that it is desired to call attention to. The first one is that on page 108, in discussing the Arnold power circuit patent (1,329,283), it is admitted that the prior Arnold patent (1,129,943) "contains a full disclosure of this invention". Having in mind that this prior Arnold patent issued on March 2, 1915, whereas the Arnold patent in suit was not applied for until July 30, 1918, the significance of this admission will be apparent.

In conclusion we cannot refrain from commenting upon respondents' characterization of petitioner as an "infringer" and their quotation of platitudes of patent law with respect to an infringer who questions the value, utility, extent of use, and commercial success of the inventions disclosed by patents infringed by him. Of course, in the situation presented by the facts in this case, the petitioner is not an "infringer" in the sense respondents seek to imply. It is true that petitioner admits that the alleged inventions of the patents in suit are incorporated in the amplifiers sold

to it by the American Transformer Company. Its admission is induced, largely if not entirely, by the fact that, as sold to petitioner, the amplifiers were assertedly made under and incorporated the inventions of those patents. Thus, petitioner is neither an infringer in the literal, legal or tortious sense.

Conclusion.

The decision of the Court of Appeals below was in error and should be reversed, and the cause remanded to the District Court for the Southern District of New York, with instructions to dismiss the Bill of Complaint.

Respectfully submitted,

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IN THE

Supreme Court of the United States

October Term, 1937

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

BRIEF FOR PETITIONER ON REHEARING

[redacted]
Counsel for Petitioner

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IN THE

Supreme Court of the United States

October Term, 1937

No. 357

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

BRIEF FOR PETITIONER ON THE TWO QUESTIONS ON WHICH REHEARING WAS GRANTED.

Statement.

This Court granted a writ of certiorari in this case (302 U. S. 674). The cause was argued and a majority opinion (per Mr. Justice BUTLER) was filed May 2nd, 1938, affirming the Circuit Court of Appeals below, Mr. Justice BLACK dissenting (304 U. S. 175). A rehearing was granted (304 U. S. —, 82 L. Ed. 1045) limited to the first two questions presented by the petition for writ of certiorari.

For the convenience of the Court petitioner files its present brief confined to the two questions on which the rehearing was granted.

The Facts.

1. Three suits were brought by respondents against petitioner in the District Court for the Southern District of New York to restrain infringement of twelve patents. Four of them were withdrawn at or prior to the trial. Six of the patents were found valid and infringed, and two were found invalid. The case here involves only the six patents which were held valid and infringed.

2. All the patents in suit are included in a patent pool to which respondents and the other large companies of the electrical industry, including Radio Corporation of America, General Electric Company and Westinghouse Electric and Manufacturing Company, contributed all of their respective relevant patent rights, which pool has become popularly known as "The Radio Trust" (Vol. III, pp. 1305-1413).

3. By the pooling arrangement Radio Corporation of America was vested with the sole authority to grant licenses under all the patents of the pool to manufacturers engaged in the manufacture and sale of apparatus embodying the inventions of the respective patents of the pool.

4. Under this authority Radio Corporation of America, with respondent, American Telephone and Telegraph Company joining as a co-licensor, granted to a number of apparatus manufacturers (Vol. I, pp. 332-335) licenses under all the patents in the pool,

> "to manufacture * * * and sell only for radio amateur reception, radio experimental reception, and radio broadcast reception * * *"

(Vol. III, p. 1415).

5. One such manufacturer who acquired a license was the American Transformer Company which, under its license, manufactured and sold apparatus technically known as a vacuum tube amplifier (Vol. III, p. 1414 *et seq.*).

6. A vacuum tube amplifier is a standard piece of electrical equipment utilized for amplifying electric currents. It consists solely of the necessary electrical instrumentalities, including vacuum tubes, to which current is supplied to the "input" end, and from which the amplified current is obtained from the "output" end.

Obviously, this standard instrumentality can be used wherever electric current amplification is desired, and, therefore, for perhaps hundreds of purposes in as many different industries.

7. Pursuant to the requirement of paragraph 5 of the license agreement (Vol. III, p. 1418), the American Transformer Company attached to each amplifier it sold, a plate or label bearing the legend (Vol. II, p. 734)—

> "License Notice—This apparatus is licensed only for radio, amateur, experimental and broadcast reception under the following patents of the Radio Corporation of America and associated companies."[1]

As above noted, the amplifier made and sold by the American Transformer Company can actually be used for any of the many purposes for which amplifiers are used, besides those recited in the foregoing "License Notice".

8. Petitioner, over a considerable period of time, and in the ordinary course of its business, purchased many hundreds of amplifiers from the American Transformer Company with this "License Notice" attached thereto, and

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[1] The patents in suit were included in the patents to which the "License Notice" applied.

proceeded to employ them in talking motion picture equipment, being engaged solely in the business of making and leasing such motion picture equipment (Vol. I, p. 65, fols. 193-194). Petitioner never made or sold any amplifiers (Vol. I, p. 387, fol. 1160).

9. The American Transformer Company, exercising its power of *sale* under the license, *sold* its amplifiers to petitioner (Stipulation, Vol. I, fol. 194), received its full selling price therefor, and regularly paid its royalties to Radio Corporation of America under its license agreement with that company, reporting to that company the sales of the amplifiers made to petitioner (Vol. III, pp. 1568-1614). Petitioner was well known to Radio Corporation of America, and to respondents; they also knew that petitioner's business was confined exclusively to the making and leasing of talking motion picture equipment (Vol. I, pp. 65, 371, 379, 469, 476, 507).

10. The present suit was instituted charging infringement of the patents in suit under which the amplifiers were manufactured and sold under license by American Transformer Company, because the *use* to which petitioner put the amplifiers was outside the alleged "licensed" use specified in the "License Notice" attached to the apparatus. In other words, although the amplifiers had been bought and paid for, with *title* passing thereto, and although tribute to the patents had been paid by the selling licensee, the patent owner, by a "notice" attached to the apparatus, sought to retain control over the *use* to which the amplifiers were subsequently put by the purchaser.

11. For more than a year after the present suit was begun, Radio Corporation of America retained the royalties paid by its licensee, the American Transformer Com-

pany, on the amplifiers sold by the licensee to petitioner, with conceded full knowledge of the regularly continued sales of the amplifiers to petitioner by the American Transformer Company throughout such period, and of the use to which petitioner put them (Vol. II, p. 1216; Vol. III, pp. 1568-1614).

12. Though this suit was commenced in September, 1929, and the license of American Transformer Company to make and sell these amplifiers did not expire until August, 1931 (Vol. III, p. 1421), the respondents never protested to the licensee, the license was never cancelled nor was the American Transformer Company ever sued for any alleged breach thereof. Indeed, the American Transformer Company was permitted to continue to make and sell the amplifiers to petitioner, without interference, until the above expiration date of its license (Vol. I, p. 344, fol. 1031; p. 349, fol. 1047).

The Two Questions on which the Rehearing was Granted.

The two questions on which rehearing has been granted are as follows:

1. Can the owner of a patent, by means thereof, restrict the *use* made of a device manufactured under the patent, after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor?

2. Can a patent owner, by means of the patent, merely by a "license notice" attached to a device made under the patent and sold in the ordinary channels of trade by the patentee or by his licensee to make and sell, place an enforceable restriction on the purchaser thereof as to the *use* to which the purchaser may put the device?

Substance of the Opinion of the Court of Appeals Below.

The Court of Appeals for the Second Circuit answered the two questions in the affirmative, disregarding the numerous decisions of this Court to the contrary[2] with the statement that the holdings of those cases are not necessarily controlling on the point here in issue (91 Fed. (2) 922 at p. 928; Vol. III, p. 1723). The pertinent statements of this Court in the *Boston Store* case (246 U. S. 8) and in the *General Electric* case (272 U. S. 476) that patented articles once sold, are put beyond the confines of the patent law, were characterized as "obiter",[3] and the Court of Appeals concluded its opinion on this subject with the statement:[4]

> "This circuit recognized that the patentee may extend his monopoly beyond a sale by a licensee."

Summary of Argument.

The facts and law applicable to the two questions to which the rehearing is confined will be the first two points discussed, whereby it will be established that both of these questions should be answered by this Court in the negative.

Thereafter, in the order named, and as separate points, there will be pointed out (Point III) the error of the Court of Appeals below in its treatment of the issues involved; (Point IV) the fallacy of respondent's contentions in the case; and (Point V) the error of the prior majority opinion of this Court in the present case.

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[2] *Motion Pictures Patents Co.* v. *Universal Film Co.*, 243 U. S. 502; *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Boston Store* v. *American Graphophone*, 246 U. S. 8; *United States* v. *General Electric Co.*, 272 U. S. 476.

[3] 91 Fed. (2) 922, 928; Vol. III, p. 1724.

[4] 91 Fed. (2) 922, 929; Vol. III, p. 1724.

Argument.

This suit is concerned with talking motion picture equipment, and therefore involves the same industry which this Court in the *Motion Picture Patents* case[5] said

> "must be recognized as an important element in the amusement life of the nation"[5].

Just as in the Government suit in that case,[6] license agreements of the very type entered into between respondents and the American Transformer Company, and based also on a pooling of patents relating to motion picture apparatus, were held illegal and violative of the anti-trust laws, these respondents, too, with respect to the same industry and the same equipment, have already been found to have established and maintained an illegal monopoly in violation of the same laws.[7]

In consequence, both as to subject matter and as to the principles of law involved, the case presents matters of vital public importance.[8]

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[5] *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502, 519.

[6] *United States* v. *Motion Picture Patents Co.*, 225 Fed. 800, appeal dismissed 247 U. S. 524; cited with approval in *Standard Oil Co.* v. *United States*, 283 U. S. 163, 174.

[7] *Stanley Company of America, Inc.* v. *American Tel. & Tel. Co., et al.; General Talking Pictures Corporation* v. *American Tel. & Tel. Co., et al; Duovac Radio Corporation* v. *American Tel. & Tel. Co., et al.*, preliminary injunction granted 4 Fed. Supp. 80; on final hearing 18 Fed. Supp. 650. The action in the case at bar was not brought to trial until after the preliminary injunction had been granted against respondents in that anti-trust suit.

[8] Patent pools offer no avenue of escape from the prohibitions of the anti-trust laws, and if beyond the scope of the patent law, give sufficient ground for this Court of its own motion, the entire record being before it on certiorari (*Story Parchment Co.* v. *Paterson*, 282 U. S. 555, 567), to refuse to lend aid to the claims of any patentee arising out of such or other inequitable situations (*Oscanyon* v. *Ams Co.*, 103 U. S. 261, 267; *Continental Wall Paper Co.* v. *Voight & Sons Co.*, 212 U. S. 227, 262; *United States* v. *American Tobacco Co.*, 221 U. S. 106, 181; *Keystone Driller Co.* v. *General Excavating Co.*, 290 U. S. 240, 245.

The suit is an attempt, by means of patents, to restrict the *use* of a standard article of commerce made and sold thereunder by a licensee under the patents, valid title to which article concededly has passed to the purchaser.

There is no question of contract or general law in the case. Nor, in so far as the patent law is concerned, is the attempted restriction one which in any sense is inherent to the structure of the article. The amplifiers sold by American Transformer Company could have been used for amplifying current in a railway signaling system, in a loud speaker system in an auditorium, for electrically recording phonograph records or the electrical reproduction thereof, in electro-medical laboratories, in power plants—in fact, in any industry where amplification of electric current is desired.

In essence, therefore, neither the uses of which the amplifier was capable, nor the purported restricted use to which the license notice sought to confine it, were dependent upon the particular construction or arrangement of the amplifier made and sold.

This controversy, concerned as it is exclusively with the rights of *purchasers* of patented articles, and not with the relations between *patentees and their licensees,* presents then but one question,—the validity *under the patent law* of the attempted *use* restriction here.

Respondents assert their power under the patent law to parcel out the single monopoly of their patents amongst purchasers of articles made and sold thereunder so as to create an unlimited number of sub-monopolies, one for each possible use of the amplifier. Of course, this cannot be lawfully done. Long ago, in a case in which the facts in this respect, at least, were like those here presented (*Washing Machine Co.* v. *Earle,* 29 Fed. Cas. 17219, p. 332), the

Circuit Court pointed out the impropriety and invalidity of any such attempt. The Court said (p. 334):

> "Goodyear, by virtue of his patent, might have manufactured it (vulcanized rubber) all himself, and sold it for such price as he could get; *but his patent gives him no power to control the use which persons who purchase may make of it. Vulcanized rubber may be applied to a thousand purposes, from a tube to a steam engine, but this patent gives no power to the patentee to parcel out his one monopoly into a thousand sub-monopolies.*" (Matter in parenthesis ours.)[9]

The decisions of this Court leave no room for doubt on this primary question. In a continuous line of authorities, unbroken except for the subsequently overruled *Dick* case,[10] and culminating in the *Boston Store* and first *Shoe Machinery* cases,[11] this Court established, restated and applied the rule that the *sale* of a patented article by the patentee or one having the power of sale, *exhausts the monopoly conferred by the statute and forever frees that article from that monopoly.*

Now, however, this Court, having before it in the case at bar what is perhaps the last or only remaining attempted restriction, namely the *manner* or *purpose* of use of the patented article sold, if its present decision remains unaltered, will sanction such restrictions on patented articles after their sale. Thus, though under those prior decisions *no* restrictions may be placed by a patentee on an article sold under the patent with respect to its *place* of use, its *time* of use, the *materials* used with it, or its *resale price*, the patentee may *now* control its *manner or purpose of use* throughout its useful life.

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[9] Italics in this brief ours unless otherwise stated.

[10] 224 U. S. 1.

[11] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8, 25; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32, 58.

In reaching that decision the Court has apparently overlooked the fact that there is no distinction in principle between any of these restrictions; and this is emphasized by the failure of the Court to distinguish the restriction here attempted, in principle, or in law, from the other restrictions which the Court has consistently invalidated.

In consequence, the two questions presented in this cause on rehearing go squarely to the invalidity of the attempted restriction which respondents, by means of their patents, seek to impose upon the use to which petitioner may put the amplifiers it has purchased from a manufacturer licensed to make and sell them.

POINT I.

The owner of a patent cannot, by means of the patent, restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade and full consideration paid therefor.

The Court of Appeals for the Second Circuit expressly held (91 Fed. (2) 922, 929; Vol. III, p. 1724):

> "* * * the patentee may extend his monopoly beyond a sale by a licensee."

Thus, its decision is to the effect that a patentee may, by means of the patent, maintain a control over the patented article after it has been bought and paid for and tribute to the patents paid by the selling licensee, and hold the purchaser as an infringer if the article is used other than as prescribed by a mere "notice" attached to the article when sold. If this decision is sound, the owner of a patent for

an ordinary pocket lighter (sold across the counter in any retail cigar store) can attach a notice thereto that the lighter is licensed for use only for lighting cigarettes, and successfully maintain a suit for infringement against the purchaser if he uses it for lighting cigars. The absurdity of the logical and practical consequences of the decision in the case at bar will thus be seen.

To proceed a step further, then, the ruling by the Court of Appeals above quoted would in effect make of the patent law the "perfect instrument of favoritism and oppression" (*Motion Picture Patents* case, 243 U. S. 502, 515). In evolving and applying, for almost one hundred years, a doctrine precisely to the contrary of that expressed by the Court of Appeals, and holding that a sale exhausts the monopoly of the patent owner as to the particular article involved, this Court, following *Kendall* v. *Winsor*, 21 How. 322, has invariably interpreted the patent law so as to consider "the benefit to the public or community at large * * *" as "the primary object in granting and securing that monopoly", rather than "the promotion of private fortunes" (*Motion Picture Patents* case 243 U. S. 502, 511, 519).

A. Outline of the progressive establishment of the rule by this Court that the sale of a patented article by the patent owner or by a licensee having a power of sale, removes the article from the patent monopoly.

(1) This principle was first expressed and applied so as to give a right of use unlimited in point of time, to one who had purchased a patented article from a person whose patent rights, either as owner or territorial assignee, were expressly limited to the original term of the patent. In those

cases, therefore, the holder of the extended term was held to have no rights with respect to the article so purchased.[12]

(2) The rule was thereupon extended to cases involving purchases of patented articles from territorial assignees who themselves had no right to make, sell or use outside the territory to which they were restricted. It was there held (a) that the *purchasers* were not bound under the patent law by the territorial restrictions of their vendors, and could use the articles elsewhere;[13] (b) that such vendors were not chargeable with infringement for deliberately selling for use in other territory;[14] and (c) that dealers who purchased such patented articles from territorially limited vendors, could sell or use them elsewhere as well, free from the monopoly of the patent.[15] In each of the cases it was held that *though all of the parties concerned had full knowledge of the vendor's restricted rights,* the purchasers of the patented articles nevertheless took free of all restrictions under the patents.

(3) Thereupon the attempt by patentees to retain control over patented articles after their sale, by the device of express restrictions in the guise of "license notices" or special agreements with the vendor, intended to enable the patentee to control the resale prices [16] or the use of those articles by the purchaser,[17] met with a like fate (See Point

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[12] *Wilson* v. *Rousseau,* 4 How. 646; *Simpson* v. *Wilson,* 4 How. 709; *Bloomer* v. *McQuewan,* 14 How. 539; *Bloomer* v. *Millinger,* 1 Wall. 340.

[13] *Adams* v. *Burke,* 84 U. S. (17 Wall.) 453.

[14] *Hobbie* v. *Jennison,* 149 U. S. 355.

[15] *Keeler* v. *Standard Folding Bed Co.,* 157 U. S. 659.

[16] *Bauer* v. *O'Donnell,* 229 U. S. 1; *Straus* v. *Victor Talking Machine Co.,* 243 U. S. 490; *Boston Store* v. *American Graphophone Co.,* 246 U. S. 8.

[17] *Motion Picture Patents Co.* v. *Universal Film Co.,* 243 U. S. 502, overruling *Henry* v. *A. B. Dick Co.,* 224 U. S. 1.

II). In each, as this Court stated in the *Boston Store* case, the reason for the decision was the simple but fundamental ground that, *title* to the patented article having passed, the monopoly of the patent law cannot "be extended beyond the scope of that law or, in other words, applied to articles after they have gone beyond its reach".[18]

B. Analysis of cases in which the rule was considered or applied.

From the summary just concluded, it is evident that every attempted restriction on a patented device after it has been sold, by means of the patent under which it was made, has been invalidated by this Court on the ground that a sale exhausts the monopoly of the patent owner as to the particular article involved.

1. *Attempted Restrictions on Time of Use.*

Thus, in *Wilson* v. *Rousseau*, 4 How. 646, and *Simpson* v. *Wilson*, 4 How. 709 (1846), this Court held that one who *purchased* a patented article from a patent owner during the original term of the patent, continued to have the right to use it beyond any limitation in time, though the rights of an assignee of the original patent itself were held to have expired with the term, as against the claims of one who had obtained an extension of the patent term under the then-existing law. These cases lay the foundation for the rule that the *sale* of a patented chattel exhausts the patent rights of the seller.

This rule was redefined and again applied six years later in *Bloomer* v. *McQuewan*, 14 How. 539 (1852),—another case dealing with attempted restriction on the *time of use*. It was there held that the purchaser of a patented

[18] 246 U. S. 8, 26.

article during the period to which the patent was first limited, was entitled to continue to use it during the extended term, though the right of his vendor,—a territorial assignee—in the patent itself, was confined to the original term. This Court distinguished between the grant of a patent right such as a *license*, on the one hand, and the *sale* of an article made under that right, on the other. Chief Justice TANEY, who wrote the prevailing opinion in this and the earlier *Wilson* cases, *supra*, stated this distinction to be "a plain one", and held (p. 549):

> "• • • the purchaser of the implement or machine for the purpose of using it in the ordinary pursuits of life, stands on different ground. In using it, he exercises no rights created by the act of Congress, nor does he derive title to it by virtue of the franchise or exclusive privilege granted to the patentee. • • • *And when the machine passes to the hands of the purchaser, it is no longer within the limits of the monopoly.*"

2. *Attempted Restrictions on Place of Use.*

The problem was presented anew in three cases between 1873 and 1895, but this time from the viewpoint of attempted restrictions on the *place of use* of patented articles after sale. In each instance this Court held that such restrictions would not be recognized by the patent law once the patented articles had passed by sale into the channels of trade.

Thus, in *Adams* v. *Burke*, 84 U. S. (17 Wall.) 453 (1873), it was held that one who purchased a patented article in the restricted territory of his vendor, acquired the unrestricted right to use it anywhere. This Court there held (p. 456):

> "But, in the essential nature of things, when the patentee, or the person having his rights, sells a machine or instrument whose sole value is in its use, he receives the consideration for its use and he parts

with the right to restrict that use. The article, in the language of the court, passes without the limit of the monopoly."

In *Hobbie* v. *Jennison*, 149 U. S. 355 (1893), it was held that a patent assignee for one territory was not an infringer when he sold to a person who, *to his knowledge*, intended to use the patented articles so purchased, in the territory of another assignee. The plaintiff in the *Hobbie* case sought to escape the implications of the decision in *Adams* v. *Burke* by asserting that in the *Adams* case the vendor of the patented device was *unaware* of the allegedly unauthorized use to which the purchaser put the article, but this Court, after stating that there was *full knowledge* by all parties in both cases, held (p. 363):

> "But we are of opinion that the case of *Adams* v. *Burke* cannot be so limited; * * * and that neither the actual use of the pipes in Connecticut, *or a knowledge on the part of the defendant that they were intended to be used there*, can make him liable."

The question then arose in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659 (1895), whether a *dealer* could be restrained from selling patented articles in his store in Massachusetts, having purchased them from the Michigan assignee with *knowledge* that the right to make, use and sell them for Massachusetts belonged to another. This Court refused to hold the dealer as an infringer, stating, in effect, that a free citizen may buy anywhere, and, being the owner of what he buys, may sell it anywhere. Reviewing *Adams* v. *Burke* and *Hobbie* v. *Jennison*, this Court held (pp. 666-667):

> "Upon the doctrine of these cases we think it follows that one who buys patented articles of manufacture *from one authorized to sell them* becomes possessed of an absolute property in such articles, unrestricted in time or place. * * *

> The conclusion reached does not deprive a patentee of his just rights, because no article can be unfettered from the claim of his monopoly without paying its tribute. *The inconvenience and annoyance to the public that an opposite conclusion would occasion are too obvious to require illustration.*"

3. *Attempted Restrictions on Resale Prices and Use:*

The doctrine of the foregoing cases was restated and reapplied in *Bauer* v. *O'Donnell*, 229 U. S. 1 (1913); *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490 (1917); *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8 (1918), and *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502 (1917), of which cases the three first named were concerned with the efficacy of attempted *resale price* restrictions, and the fourth with attempted limitations on *use*. In each of these cases (considered more fully in Point II of this brief), the patent owner sought to accomplish, by the device of "license notic[illegible] attached to patented articles upon their sale, what thi[illegible]ourt had expressly refused to sanction in the earlier decisions we have just reviewed. Here, too, this Court, on the same principle which there governed its decisions, invalidated the device as an attempt to project the patent monopoly beyond its rightful scope.

Thus, in passing upon attempted restrictions as to *resale prices* in *Bauer* v. *O'Donnell*, 229 U. S. 1, this Court held (p. 17):

> "The right to vend conferred by the patent law has been exercised, and the added restriction is beyond the protection and purpose of the act. This being so, the case is brought within that line of cases in which this court from the beginning has held that *a patentee who has parted with a patented machine by passing title to a purchaser has placed the article beyond the limits of the monopoly secured by the patent act.*"

Some years later, in *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8, this Court summarized its holdings in *Bauer* v. *O'Donnell* in words strikingly apposite now, saying (p. 23):

> "In other words, the decision was that *a patentee could not use and exhaust the right to sell, as to which a monopoly was given him by the patent law, and yet by conditions and stipulations continue that law in effect so as to make it govern things which by his voluntary act were beyond its scope.* And • • • as a result, where an article has been sold and passed beyond the monopoly given by the patent law, remedies on the theory of infringement were not applicable to acts done which could not have that character • • • ."

In the same case, speaking in the broadest terms of the rejection of attempted *use* restrictions in the *Motion Picture Patents* case, 243 U. S. 502, this Court continued (p. 25):

> "Reiterating the ruling in the two last cases, (referring to *Bauer* v. *O'Donnell* and *Straus* v. *Victor Talking Machine Co.*) it was again decided that, as by virtue of the patent law, *one who had sold a patented machine and received the price, and had thus placed the machine so sold beyond the confines of the patent law, could not by qualifying restrictions as to use, keep under the patent monopoly a subject to which the monopoly no longer applied.*" (Matter in parenthesis ours.)

Finally, in *United States* v. *General Electric Company*, 272 U. S. 476 (1926), this Court, considering the rule as settled doctrine, said (at p. 489):

> "*It is well settled, as already said, that where a patentee makes the patented article and sells it, he can exercise no future control over what the purchaser*

may wish to do with the article after his purchase. It has passed beyond the scope of the patentee's rights."

Summary.

These decisions show a consistency in ruling which is outstanding in the respect that it has never been departed from or modified, regardless of the guise in which attempted restrictions have been presented.

The fundamental reason underlying all of the cases appears to be the simple fact that this Court recognized and gave full effect to the principle that once the patented article was sold and the price paid, the article was forever outside the monopoly of the patent, and became, like any ordinary chattel,[19] owned by the purchaser, to be used or done with as he saw fit, without hindrance by or under the control of the patent owner.

This *common* fundamental ground, rising above mere questions of form, cannot be, as respondents contend, either the *particular* ground that price fixing is in itself unlawful, or the *particular* ground that the attempt to monopolize unpatented articles is in itself unlawful. The one thing common to them is that in both, *what the patent owner sought to control lay outside of the monopoly.* The patentee's sole recourse in such event, this Court said in the *Motion Picture Patents* case,[20] is to the method of *special contract,* but not to the patent law which permits no restrictions on patented articles after their sale.

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[19] *Dr. Miles Medical Co.* v. *Park & Sons,* 220 U. S. 373, citing with approval *Park & Sons* v. *Hartman,* 153 Fed. 24, 39 in which it was held that "a covenant which may be valid and run with land will not run with or attach itself to a mere chattel". See, to the same effect, *Taddy* v. *Sterious,* L. R. (1904) 1 Ch. 354, 358; and *Barker* v. *Stickney* (1919), 1 K. B. 121, 132.

[20] 243 U. S. 502, 509.

Therefore, for each and every one of the reasons so clearly stated in the foregoing decisions of this Court, the attempted restriction in the present case should be as emphatically rejected and invalidated, and the decision of the Second Circuit Court of Appeals reversed, and the cause remanded to the District Court with instructions to dismiss the bill.

POINT II.

A patent owner, merely by a "License Notice" attached to a device made under the patent and sold in the ordinary channels of trade, cannot, by means of the patent, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device.

A. Application of the Rule to "License Notice" cases.

When this Court, in its decisions from *Bloomer* v. *McQuewan*, 14 How. 539 to *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, repeatedly construed the exercise of the right to vend under the patent law as granting to purchasers of patented articles full title thereto, free from any restrictive conditions under that law, patent owners renewed their efforts to fasten control on patented articles after their sale, by the device of attaching "License Notices" to those articles, or by restrictive agreements with the purchasers. However, that method was also held to be illegal, for this Court with unfailing regularity brushed aside "the guise of license or otherwise" (*Boston Store* v. *American Graphophone Co.*, 246 U. S. 8, 24) and refused to hold such purchasers as infringers.

Some time before the "license notice" issue was presented to this Court in patent cases, it had decided against the practice in the closely analogous copyright cases of *Bobbs-Merrill* v. *Straus*, 210 U. S. 339 and *Scribners* v. *Straus*, 210 U. S. 352, in which resale price restrictions by "notice" on copyright books, after their sale, were held void. The use of such "license notices" on sold patented articles was termed "dangerous doctrine" by a former Assistant Commissioner of Patents,[21] who warned against such practice, and referred to its occasional support in the lower Federal Courts before 1912. When the question did come before this Court the entire system of "license notice" restrictions sought to be attached to patented articles upon their sale, was finally repudiated in its entirety.

1. *Attempted "License Notice" Restrictions on Resale Prices.*

(a) In *Bauer* v. *O'Donnell*, 229 U. S. 1, the first of the series of patent cases in which the issue was raised, a retail drug store proprietor was sued for patent infringement for having disregarded a notice on original Sanatogen packages he purchased, purporting to license their "sale or use at a price not less than one dollar". The notice also recited the purchase as constituting an acceptance of the condition, with right of reverter in the event of violation.

The case came up on certificate from the Court of Appeals of the District of Columbia and "the question presented restricted the case to determining whether the right to limit the price existed because within the monopoly granted by the patent law" (*Boston Store* v. *American Graphophone*, 246 U. S. 8, 22-23, interpreting the *Bauer* decision).

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[21] Walter H. Chamberlain in 6 Illinois Law Review 357 (January, 1912).

In deciding that no right under the patent law was involved, and that the purchaser was free to use the patented article at will, Mr. Justice Day, writing for this Court, said in the *Bauer* case (p. 13):

> "The sale of a patented article is not essentially different from the sale of a book. In each case to vend is to part with the thing for a consideration."

In reaching the conclusion that once the right to vend, conferred by the patent law, has been exercised, "the added restriction is beyond the protection and purpose of the act" (229 U. S. 1, 17), this Court expressly predicated its decision, *inter alia*, on *Bloomer* v. *McQuewan*,[22] *Adams* v. *Burke*,[23] and *Keeler* v. *Standard Folding Bed Co.*,[24] thus bringing its decision precisely in line with the doctrine *fundamental* to all those cases, that once *title* to a patented article has passed to a purchaser, and the right to vend thus exhausted with respect thereto, the article has passed "beyond the limits of the monopoly secured by the patent act". (*Bauer* v. *O'Donnell*, 229 U. S. 1, 17).

(b) In *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490, this Court was next called upon to decide the legal effect of a "License Notice" affixed to a patented machine. The Victor Company manufactured phonographs and distributed them under "license contracts", reserving title to the machine until the expiration of its patents and compliance with certain conditions appearing on a "License Notice". This license authorized dealers to convey a license to use the machine upon a minimum payment of $200. The defendant bought a quantity of the machines at less than the fixed price stated in the "License Notice". The Victor Company

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[22] 14 How. 539.
[23] 84 U. S. (17 Wall.) 453.
[24] 157 U. S. 659.

sought to enjoin this alleged infringement by preventing the defendant from selling them, presumably at lower prices.

This Court, in dismissing the bill for infringement, held the "Notice" invalid, and the full purport of its holding was later summarized in the following language in *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8, 24:

> "Basing its action upon the substance of things, and disregarding mere forms of expression as to license, etc., the court held that the contract was obviously in substance like the one considered in the *Miles Medical Case* and not different from the one which had come under review in *Bauer* v. *O'Donnell*. Thus brushing away disguises resulting from forms of expression in the contract, and considering it in the light of the patent law, it was held that the attempt to regulate the future price or the future marketing of the patented article was not within the monopoly granted by the patent law, in accordance with the rule laid down in *Bauer* v. *O'Donnell*."

It is interesting to note that in the *Straus* case, this Court, undeceived by the patentee's use of the word "license" to cloak what was really a *sale*, found that the facts involved an attempted price restriction on patented articles "after they have passed into the possession of dealers and of the public", and thereupon held (p. 501):

> "* * * we conclude that it falls within the principle of *Adams* v. *Burke*, 17 Wall. 453, 456, and of *Bauer* v. *O'Donnell*, 229 U. S. 1."

Adams v. *Burke*, on the page indicated in the *Straus* opinion, holds that upon sale "the article, in the language of the Court, passes without the limit of the monopoly" ("the language of the Court" refers to *Bloomer* v. *McQuewan*, 14 How. 539). That, also, is the principle restated

in *Bauer* v. *O'Donnell.* Price limitation was no issue in *Adams* v. *Burke,* or *Bloomer* v. *McQuewan.* The only principle common to the *Adams, Bloomer, Bauer,* and *Straus* cases is that *a sale, whether with or without a license notice, takes the patented article out of the patent monopoly.*

(c) Thereafter, in *Boston Store of Chicago* v. *American Graphophone,* 246 U. S. 8, the "license notice" method which had failed of recognition in the *Bauer* and *Straus* v. *Victor* cases, was supplanted by *written contracts* between marketing agents of the patentee and purchasers of the patented articles whose resale prices were sought to be controlled thereby.

The District Court in that case conceded that a patentee

> "cannot make a notice attached to the article discharge the function of a 'covenant running with the land'" (225 Fed. 785, 787)

but was misled by the contract device, and sustained the bill alleging patent infringement because of a violation of that agreement.

This Court, however, on a certificate from the Circuit Court of Appeals for the Seventh Circuit, inquiring whether "the recited facts disclose that some right or privilege granted by the patent laws has been violated" answered in the negative and dismissed the bill. After reviewing its prior decisions invalidating restrictions sought to be imposed under the patent law on patented articles after their sale, this Court held (p. 25):

> "Thus concluding, it becomes, we think unnecessary to do more than say that we are of opinion that the attempt in argument to distinguish the cases by the assumption that they rested upon a mere question of the form of notice on the patented article, or the

> right to contract solely by reference to such notice, is devoid of merit, since the argument disregards the *fundamental ground* upon which, as we have seen, the decided cases must rest."

That "fundamental ground" of which this Court spoke, was that the monopoly of the patent cannot (p. 26):

> "be extended beyond the scope of that law or, in other words, applied to articles after they have gone beyond its reach".

Indeed, so firmly did this Court deem that rule to be established that it expressly rejected any further attempts "judicially to correct doctrines which by reiterated decisions have become conclusively fixed" (p. 26).

2. *Attempted "License Notice" Restrictions on Use.*

The doctrines of the foregoing cases were again presented to this Court, but from a different aspect, in *Henry* v. *A. B. Dick Co.*, 224 U. S. 1, and *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502. In those cases renewed attempts were made by patent owners to control patented articles in the hands of purchasers, this time by "license notices" attached to the articles, purporting to restrict their *use*.

(a) In the *Dick* case, by a four to three decision, such a notice, requiring the patentee's unpatented supplies to be used with the patented device, was held effective and its violation construed as an infringement. That conclusion was arrived at by reasoning that if a patentee by virtue of his patent, could reserve *all* uses, he surely could restrict *some* on articles made and sold under the patent. The fallacy in that argument was, of course, that it failed

to recognize that rights with respect to all of the parts collectively, are not necessarily rights with respect to any isolated part. Therefore, though the right to make, vend or use could be reserved or granted in part, it could not follow a patented article into the hands of a *purchaser* as a restriction in the nature of "a license of the *use*", to quote from this Court's analysis of the *Dick* decision, in the *Boston Store* case (246 U. S. 8, 22).

(b) This entire question was re-examined, however, and the *Dick* case was expressly overruled in the *Motion Picture Patents* case. There this Court had presented to it two closely analogous questions—(1) whether a patentee who licenses the manufacture and sale of the patented device can, by a mere notice attached to the article, limit the purchaser from such licensee to films which were not part of the patented machines, and (2) whether the patentee, by a mere notice so attached, can reserve conditions to be fixed in the future.

Both questions were answered in the negative by this Court. With respect to the "License Notice", it held (p. 509):

> *"The statutes relating to patents do not provide for any such notice and it can derive no aid from them."*

This Court thereupon held (p. 516):

> "* * * it is not competent for the owner of a patent by notice attached to its machine to, in effect, extend the scope of its patent monopoly by restricting the use of it to materials necessary in its operation".

(To the same effect, see the later cases of *Carbice Corp.* v. *Amer. Patents Development Corp.*, 283 U. S. 27; and *Leitch Mfg. Co.* v. *Barber Co.*, 302 U. S. 458.)

In reaching this result, this Court held that the exclusive right to *use* is no greater than the exclusive right to *vend* a patented machine, and that its previous decision in *Bauer* v. *O'Donnell* had interpreted the exercise of the right to vend, as freeing the article "*of every restriction which the vendor may attempt to put upon it*" (*Motion Picture Patents* case, 243 U. S. 502, 516).

Of course, there is no distinction in principle between attempting to restrict the materials to be used by an attached "License Notice", and attempting to restrict the use of the device itself. *Both of the attempted restrictions consist of nothing more or less than attempts on the part of the patent owner to "extend the scope of its patent monopoly" in a manner neither contemplated nor permitted by the patent statutes.*

The only distinction that exists between the decisions of this Court in the *Bauer, Straus, Boston Store* and *Motion Picture Patent* cases, on the one hand, and the case at bar, is in the *character* of the restrictions sought to be effected by the "License Notice" attached to the goods sold. Because the Court of Appeals differentiates the cases in this fashion when there is and should be no distinction between them, it is necessary for this Court to clarify the situation by a decisive holding (in accord with its decisions), that *no* valid restriction on the use of a patented article purchased from the patentee or his licensee, and the price paid therefor, can be effected by a mere "License Notice" attached to that article.

B. Extra-Judicial Comment on the extent of the Rule.

The force and extent of the rule, as established and applied in the foregoing cases, is fully reflected in the references to it made by leading writers on the law of patents.

Thus, Professor Williston recently stated (5 Williston on Contracts, 1937, pp. 4630-31):

> "• • • It seems, indeed, to have been suggested by the Supreme Court of the United States, that as to patented articles there is an inherent inconsistency in selling property and imposing a restriction on the buyer (citing the *Boston Store* case). This can only mean, however, that the patent laws give no protection to restrictive promises exacted from a *buyer* and that they must stand or fall under the common law as if the article was unpatented. • • • Certainly, this result cannot be achieved by mere notices on patented articles." (Citing the *Straus* v. *Victor, Motion Picture Patents* and *Carbice* cases.) (Matter in parenthesis ours.)

Professor Chafee, commenting on this Court's decision in those cases, also points out (41 Harvard Law Review 945, 1002):

> "When the patented article is sold it appears to pass outside the scope of the patentee's monopoly in every respect. At least I find no satisfactory case to the contrary."

and, on the same page, the author states:

> "In this country the vital distinction is drawn *when title to the article passes.*"

As put by this Court in *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32, 58, a patentee "cannot grant the *title* and retain the incidents of it".

And in Walker on Patents (1929), Vol. I, the rule is summarized in the following language (p. 425):

> "But the purchaser of a patented apparatus, from the owner of the patent thereon, acquires whatever right that patent covers, to use that apparatus in accordance therewith, even where it is capable of a

different use, and *by such sale the apparatus is thereby rendered free of every restriction which the patentee may attempt to put upon it*". (Citing *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502.)

Likewise, in 24 Ruling Case Law—Sales; Sec. 660, pp. 372-373, the rule is stated to be:

"* * * So the patentee cannot reserve a right to place future restrictions on the use of the patented article which will follow the article into the hands of subsequent purchasers and bind them. As regards the foregoing principle one licensed by the patentee to manufacture and sell the patented article is in the same position as a buyer from the patentee, so that a purchaser from such licensee takes free from agreements by the licensee with the patentee as to the use, etc., to be made of the patented article by the purchasers." (Citing the *Motion Picture Patents* case.)

From the foregoing it is believed to be apparent that the second question presented should be answered in the negative; and the attempted restriction in the present case, as well as the attempt to effect it by a mere "notice" attached to the patented article when sold, should be emphatically rejected and invalidated; and the decision of the Second Circuit Court of Appeals should be reversed and the cause remanded to the District Court with instructions to dismiss the bill.

POINT III.

The Court of Appeals erred in treating as "obiter" and "not necessarily controlling", the doctrine of this Court that under the patent law no future control by "license notice" or otherwise can be exercised over a patented article once it has been sold.

The Court of Appeals in the case at bar "suggests" that although this Court plainly said in the *Bauer, Straus* and *Boston Store* cases that it was deciding the issues there involved *solely under the patent law*, the real reason was a policy against resale price control (Vol. III, p. 1724). It rests that suggestion on a purported quotation from the *Boston Store* opinion, which we have been unable to find. However, what this Court did say there was that the particular contract "disclosed in the certificate" in the *Boston Store* case (246 U. S. 8, 25), was *also* void under the general law as in restraint of trade (*Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373), and that it was incapable of being made good by resort to the patent law "under the guise of a patent infringement".

To be sure, public policy at common law prohibits resale price restrictions on chattels sold in the ordinary course of trade. It does not follow, however, when such restrictions are sought to be enforced in the form of an infringement suit, simply because the articles were made and sold under a patent, that the *only* reason they are held void is because of public policy. They are held bad under the *patent law* for the simple reason that *no* restrictions on patented articles, intended to be effective after their sale, have ever been recognized by this Court (except in the *Dick* case,

which was overruled by the *Motion Picture Patents* decision). *A fortiori*, restrictions inherently invalid under the general law, will surely find no protection under the patent statute on any theory.

The vice in the holding of the Court of Appeals below becomes ever more apparent when it is recalled that where the free movement of chattels in the hands of purchasers in the ordinary channels of commerce is not involved, price restrictions have always been held *good* under the patent law. Thus, in cases involving *simple licenses* to make, use or vend, where the mutual rights of patentee and *licensee* are considered, as distinguished from transactions constituting *sales* of patented articles, the patent law permits the imposition of all manner of restrictions not in themselves illegal or violative of some special statute (*United States* v. *United Shoe Machinery Co.*, 258 U. S. 451; *Patterson* v. *Kentucky*, 97 U. S. 501). This Court has, therefore, recognized price and other restrictions *as between a patentee and his licensee*, where the license was a true one, and not a subterfuge for a sale (*Bement* v. *National Harrow Co.*, 186 U. S. 70; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32; *United States* v. *General Electric Co.*, 272 U. S. 476).

Hence, in the *Bement* case, price fixing restrictions were held valid in a contract between a patentee and its manufacturing licensee, even against the Sherman Act, a rule of decision followed in the first *Shoe Machinery* case (247 U. S. 32).

In the *General Electric* case, this Court, distinguishing between *agencies to sell* and actual *sales* of patented articles, held that agreements by the *General Electric Co.* with its licensee as to the prices at which the latter shall sell articles it makes, are valid. In other words, if a patentee

grants a *license* to make and sell, he may require the licensee to "limit the selling by limiting the method of sale and the price" (272 U. S. 476, 490). However, he can place no such restriction upon one who has *purchased* the patented article from the licensee. Thus, this Court held in that case (p. 485):

> "As long as he (the patent owner) makes no effort to fasten upon ownership of the articles he *sells* control of the prices at which his purchaser shall sell, it makes no difference how widespread his monopoly." (Matter in parenthesis ours.)

To summarize, it is obvious, then, that when this Court in *Bauer* v. *O'Donnell*, 229 U. S. 1, held resale price restrictions invalid on patented articles which had been sold, it was simply because *the patent law* permits *no* restrictions on patented articles after their sale. If public policy were the test, then the price fixing restrictions upheld in the *Bement* and *General Electric* cases (*supra*) should have been invalidated. Such restrictions were held good, however, in those cases simply because this Court there had to deal solely with the enforceability of *license agreements* as distinguished from *sales*. Recently, in *Old Dearborn Distributing Co.* v. *Seagram Distillers Corporation*, 299 U. S. 183, in upholding the Illinois Fair Trade Practice Law, this Court again stated that in the *Boston Store* and *Bauer* cases it had invalidated attempted restrictions on patented articles that had passed by sale into the ordinary channels of trade simply because the patent law afforded no basis for upholding any such restrictions, and that resort must be had to an amendment of the law to accomplish any such purpose.

So, also, the Court of Appeals below erred in holding that public policy alone moved this Court to declare invalid

the "license notice" restrictions in the *Motion Picture Patents* case, 243 U. S. 502. Public interest was indeed one of the *two* reasons stated, but the other was that the purported restriction was "plainly void, because wholly without the scope and purpose of our patent laws" (p. 519).

POINT IV.

Respondents' contentions as to the "scope" of the license of their vending licensee are without legal support.

Respondents asserted in the Courts below, and the Court of Appeals agreed, that the sales of the patented amplifiers to petitioner, though by one licensed to make and sell, were beyond the "scope" of the license and therefore an infringement of the patent just as though a license had never existed. It requires but little discussion to establish the want of merit in this contention.

In the first place the fact that the licensee undeniedly had the right to *sell* is a complete answer. If the licensee, in exercising his right to sell, is claimed to have breached some express covenant in his license agreement, the remedy —and the only remedy—of the licensor lay in *a suit against the licensee because of the breach.* No cause of action—and certainly not one under the patent law—would lie against the purchaser. This was expressly held in *Hawley* v. *Mitchell,* 1 Holmes 42, (affirmed by this Court in *Mitchell* v. *Hawley,* 16 Wall. 544). There the Circuit Court, in passing upon a license to make and *use,* said (p. 44):

> "He (the licensee, Bayley) never acquired the right to sell a single machine * * *. Had he * * * possessed the *power to sell* the patented machines, the pur-

> chaser would have acquired a title which would have been outside of the monopoly, and would have acquired the absolute right to use the machines during the extended term; *and this notwithstanding any covenants Bayley might have made not to convey such a title.* Under such circumstances, the patentee must have sought his remedy against Bayley on his covenants." (Matter in parenthesis ours.)

and, on the same page, the Court similarly pointed out that:

> "Nothing can be more evident than the purpose expressed in this instrument, to put it out of the *power* of Bayley to give any title to the machines. The very act of sale was a violation of the contract and an act of infringement." (Italics by the Court.)

Nor is respondents' contention strengthened by the attachment of the "license notice" to the amplifiers sold by their licensee, as has been established by the prior decisions of this Court hereinabove discussed. Restrictions sought to be imposed by a "license notice" attached to the article when sold, have been emphatically rejected and decisively invalidated as an unwarranted attempt to extend the monopoly of the patent to articles made and sold thereunder that have passed beyond its reach into the hands of purchasers. Surely, it cannot be seriously or successfully urged that what the patentee himself cannot do, he can nevertheless accomplish through the medium of a licensee empowered to make and sell the article with such "license notice" attached.

At common law the passage of *title* to chattels in the ordinary channels of trade is generally held to be incompatible with continued control over them by the seller (*Taddy* v. *Sterious L. R.* (1904) 1 Ch. 354, 358). The rule is not different because the manufacturer of the article

chose to sell it through an agent or jobber with instructions to attach, by label or notice, limitations on its use or resale (*Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373). In the *Dr. Miles* case, this Court held (p. 408):

> "It is an article of commerce and the rules concerning the freedom of trade must be held to apply to it."

Nor is it of any legal consequence what the manufacturing licensee in this case believed or knew of the uses to which petitioner might put the amplifiers it purchased. If, under the patent law, license notice restrictions are invalid as against purchasers of patented articles, as repeatedly held by this Court, then surely knowledge that the articles were to be used for the purposes allegedly reserved by the notice or outside of the alleged scope of the right of the seller, would not make any difference, and this Court has *expressly* so held (*Hobbie* v. *Jennison*, 149 U. S. 355).

Moreover, as would be expected, respondents' contention that the sales of the patented articles by the licensed manufacturer were beyond the alleged scope of the license to make and sell because they were used in a field other than as specified in the license agreement and by the "license notice", is the same contention that was unsuccessfully made by the patent owner, so far as we have observed, in every case cited in this brief where sales of patented articles were made by one vested with a power of sale.

Indeed, it is quite obvious that the question involving the legality of attempted restrictions on a patented article after it has been sold, could not have arisen under the charge of infringement unless the defendant in each of those cases had, according to the patent owner's argument, at least, stood in the shoes of an infringer who was not vested with the immunity from suit incident to a license.

Thus, in *Adams* v. *Burke*, 84 U. S. (17 Wall.) 453, Burke *knew* of his vendor's restricted right to sell and use and yet received by purchase the right to use the patented article beyond the territorial limits of his vendor. Indeed, the dissenting Justices in that case stood precisely on the argument here made by respondents, when they stated (pp. 458-459, 460):

> "If it be contended that the right of vending the lids to others enables them to confer upon their vendees the right to use the lids thus sold outside of the limited district, the question at once arises, how can they confer upon their vendees a right which they cannot exercise themselves? * * * In my judgment it was limited in locality, both as to manufacture and use, and that he could not convey to another what he did not have himself."

In *Hobbie* v. *Jennison*, 149 U. S. 355, the territorial assignee of a patent right *deliberately* sold the patented article made thereunder, for use in the territory of another assignee, so that the purchaser received that which the vendor did not himself possess. Yet, this Court there expressly held (p. 363):

> "*neither the actual use of the pipes in Connecticut, or a knowledge on the part of the defendant that they were intended to be used there, can make him liable.*"

And, in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, there was established the right of the purchaser to sell outside of his vendor's territory even though the vendor could not do so himself.

Similarly, the same contentions were made with respect to attempted restrictions as to resale price (*e. g.*, *Straus* v. *Victor*, 243 U. S. 490) where the resale price was specified by the license, and sales were made of the patented device at prices less than those specified. The sales were charged

to constitute "infringement" of the patent and the seller was charged to be an infringer as though no license ever existed.

Finally, in the *Motion Picture Patents* case, 243 U. S. 502, closely analogous to the present situation both as to subject matter and facts, where, too, the licensee to manufacture and sell was required to affix "license notices" to the machines it sold purporting to limit their use in the hands of purchasers, this Court held that the purchaser took free of the attempted restrictions and was not an infringer. It thereby disposed of the contention here made that the purchase was not a *licensed* act, or that the terms of the license had been exceeded by an allegedly unauthorized sale. In pointing out that the patent law has no application to cases of that character this Court further held (p. 509):

> "The extent to which the *use* of the patented machine may validly be restricted to specific supplies *or otherwise* by special contract between the owner of a patent and the purchaser or licensee is a question *outside the patent law* and with it we are not here concerned (*Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659)."

In the end, therefore, it nevertheless remains true that though a *licensee* may be restricted to use the invention of an article in a special field, or for a particular purpose (*Rubber Co.* v. *Goodyear*, 9 Wall. 788),—*once sold*, either by the patentee or by a licensee to make and sell, that same article can be used for any purpose (*Washing Machine Co.* v. *Earle*, 29 Fed. Cases No. 17219; p. 332).

In the last cited case the Circuit Court held (p. 334):

> "Any covenant between them and him (patentee and licensee) that they will not manufacture certain articles, may be valid as between the parties, *but it does not run with the rubber, like a covenant on land.*

> • • • *If his licensees do not perform their agreements, his remedy is by action against them on his covenants, and not by recourse to a chancellor to restrain third persons who have purchased vulcanized rubber from his licensees from using it, when it is theirs, for any purpose they please.*" (Matter in parenthesis ours.)

In conclusion on this subject, it should be noted that plaintiff's contentions are predicated upon the theory that inasmuch as one who owns a patent may keep his invention entirely out of use (*Paper Bag* case), he is empowered to exact any terms that he may elect as a condition to permitting his invention to be put to use. Therefore, respondents argue, there being nothing inherently illegal in restricting the *use* to which the patented device may be put, such a restriction may be validly attached to the patented device at the time of its sale, which restriction applies to the patented device after its sale and throughout its life. The utter fallacy of this contention (which was the basis of the decision in the *Dick* case, and apparently forms the basis of the outstanding majority opinion of the Court in the case at bar) is that there is a vast legal distinction between a *condition to a sale* and a condition attaching to the device itself *enforceable after its sale* in the hands of a purchaser. To put it tersely, such a control over a chattel is an incident to *title* thereto, and *no patent owner or licensee can part with title and retain the incidents thereto.* This was expressly held by this Court, in the face of such a contention, in *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32, where at page 58 this Court said:

> "Indeed, we said in the *Paper Bag Patent Case*, that he (the patentee) may keep his invention out of use. Therefore, he necessarily has the power of granting it to some and withholding it from others, a right of

selection of persons and terms. *There is, however, a limitation upon him; he cannot grant the title and retain the incidents of it; Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490; *Bauer* v. *O'Donnell*, 229 U. S. 1; *Motion Picture Patents Co.* v. *Universal Film Co. supra.*

These cases have received review and application in *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8. The principle of them was expressed to be that *where an article has been sold it passes beyond the monopoly given by the patent and conditions cannot be imposed upon it.*" (Matter in parenthesis ours.)

POINT V.

This Court's prior decision in the present case was erroneous.

In reaching its prior decision in this case (304 U. S. 175) this Court puts its opinion squarely on respondents' foregoing proposition that the sales by the licensee were outside of the *scope* of the license, and an infringement because the licensee and petitioner *knew* that the use to which the amplifiers were to be put was not one of the permitted uses specified in the license. This Court did not pass on the restricted use "notice" that the licensee, in accordance with its contract with the patentee, had affixed to the amplifiers before they passed into the hands of the petitioner as purchaser.[25]

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[25] Had the majority opinion considered the "license notices" it would have been met with the Court's own holding in the *Motion Picture Patents* case (243 U. S. 502, 509), where, in referring to the issues "arising with increasing frequency * * *" as to whether a patentee by notice can prescribe "the conditions of its use", on the *sale* of a patented article, this Court said:

"The statutes relating to patents do not provide for any such notice and it can derive no aid from them."

It is submitted that this conclusion is erroneous on principle, wholly unsupported by authority, and, indeed, contrary to the clear import of the many prior decisions of this Court hereinbefore referred to, all of which were apparently overlooked by the Court in reaching its stated conclusion.

As we have already pointed out (*ante,* pp. 32-38) it is legally immaterial *what* the scope of a license under a patent may be, for if the licensee is empowered to *sell,* the *purchaser* takes the patented article free of any restriction whatsoever *insofar as the patent is concerned.* And this is true even though one or more of such restrictions can be properly asserted by the patent owner—as breach of contract, for example—against the licensee. Obviously therefore, and under all of the prior decisions of this Court, if a licensee is empowered by the patent owner to *sell* the patented device, a purchaser acquires the patented device free of any obligations—contractual or otherwise—that may exist between the patent owner and the licensee. Moreover—and this is the controlling factor insofar as the present case is concerned—the purchaser acquires the patented device free forever from attack *by the patent,* and unrestricted as to what he may do with the device, the absolute, unconditional *title* to which is vested in him. The licensee *cannot* make a sale with the condition attached that the article shall be used or disposed of in a certain manner, *leaving the title in the purchaser in case of a breach of the condition.* Such a conditional sale would be an innovation in our system of jurisprudence, and if it should be permissible, sales of personal property could be disregarded by patentees on the plea that the patent monopoly secured to them a continued monopoly over the patented article, in spite of the general rules of law applying to the transfer of personalty.

This at once makes apparent the fallacy of the reasoning of the majority opinion of the Court that if the *sale* by the licensee was for a use *other* than that specified in the license contract, *then* the sale becomes an infringement. In reaching that conclusion this Court completely lost sight of the fact that under its reasoning it is *no act of the licensee* which does or could determine whether the sale is a legal one, *i. e.* within the license—or an illegal one, *i. e.* an infringement. In other words, *the licensee is expressly empowered to sell.* That is not questioned. And, whether or not the sale is *within* or *without* the license is determined, under the Court's reasoning, not by anything transpiring as part of the sale, *but solely by what the purchaser ultimately does with the device.* It is the *use* to which the device is ultimately put that alone determines, under the majority opinion, whether the sale was a proper one within the license or an infringing one outside of the license.

The license contract imposed no obligation on American Transformer Company to ascertain for what purpose amplifiers were bought from it. The only obligation the licensee assumed was to attach the "notice" to the amplifiers it sold. Thus, one purchasing an amplifier might make no statement as to the use to which the amplifier it bought would be put. The legality and propriety of a sale made under such circumstances cannot be questioned. If the amplifier so purchased was used for radio broadcast reception, according to respondents and the majority opinion, that was a *licensed* sale. If, however, it was used in connection with talking motion picture equipment, under the majority opinion it at once became an infringement. Similarly, if the foregoing purchaser of the amplifier, after using it for the restricted *licensed* use, thereafter sold it to another who used it for an *unlicensed* purpose, the apparatus in the

nds of the subsequent purchaser would be an infringe-
ent, whereas the identical apparatus while in the hands of
e original purchaser would not.

This absurd result illustrates quite fittingly our state-
ent that no action of the American Transformer Com-
any, which was licensed to *sell*, would determine whether
not infringement occurred. In every instance it would
e determined solely by the *use* to which the patented device
as put by the purchasers, or subsequent owners, regardless
f in whose hands it is found or through how many hands
has passed.

Apparently, in reaching the conclusion expressed in its
ajority opinion, this Court was concerned with and ap-
arently controlled by the question of whether or not the
icensee and the purchaser had *knowledge* of the restriction
n use of the amplifiers, as well as of an *intention* to violate
iat restriction. The Court apparently lost sight of the
act that where there is a *sale* of a patented article. *by a*
icensee empowered to make a sale, the patented device so
old is forever free of the patent, and that neither knowl-
dge of nor alleged intent to breach restrictive covenants
etween the patent owner and its licensee is in any respect
naterial to the question of whether or not the patented
evice *in the hands of the purchaser* constitutes an *in-*
ringement of the patents under which it was manufactured
nd sold—and this is precisely what this Court has re-
eatedly held in cases involving that identical question.

Knowledge of some purported restriction, either ex-
ressed in the form of a "notice" or implied in the limited
rant to an assignee or licensee, necessarily appears in
very case that ever came before this Court where a pat-
ntee sought to enforce a restriction against the *purchaser*
f the patented article. Yet, in none of them did the

patentee prevail. Indeed, in one instance the purchaser *actually agreed in writing* with the dealer-licensee to comply with the restriction sought to be imposed on the patented article, but was held by this Court to be free of the covenant, *under the patent law* (*Boston Store* v. *American Graphophone Co.*, 246 U. S. 8). And in another instance (*Hobbie* v. *Jennison*, 149 U. S. 355) *knowledge* by the licensed seller of the intention to use the patented article for purposes outside of the scope of the seller's right under the patent grant was held to be equally irrelevant (see *ante*, pp. 34-36).

However, as a matter of fact, this Court was in error in assuming, in its prior majority opinion, that the Transformer Company and petitioner knew the sales made were outside of the scope of the license, and hence were illegal, "unlicensed" sales. The record is quite to the contrary. The evidence is that both parties acted on advice of counsel, and in the honest belief that the Transformer Company had the right to make these sales and the petitioner to make the purchases (Vol. I, pp. 367-370, particularly fols. 1108, 1109; p. 341, fols. 1021-1022, referring to the letter exhibits in Vol. III, pp. 1563-1567).

The effect of the majority opinion is therefore to brand as a knowing infringement and a tortious act,—for infringement is a tort [26],—mere reliance on what this Court has held and repeated in decision after decision in the broadest possible terms. The Transformer Company which sold the amplifiers to petitioner, with "license notice" restrictions attached, in exact compliance with its license agreement and after notification to petitioner that that is "the only way in which we can sell them" [27], is held to infringe respondents' patents, because it *knew* petitioner intended to disregard conditions *which this Court had heretofore held*

[26] *The Carbice* case, 283 U. S. 27, 33.
[27] Vol. II, p. 732, fol. 2195.

not binding on purchasers of patented articles. And petitioner, likewise, is said to have infringed because it, too, *knew* that the licensee knew of petitioner's use of the amplifiers,—a use in strict accordance with counsel's advice that the attempted limitations on such use were illegal under the decisions of this Court. And it should be noted that counsel's advice was in strict conformity with the universal interpretation of this Court's decisions, as published by such authorities as Williston, Chafee, Walker on Patents, and Ruling Case Law (see *ante*, pp. 26-28), and as recorded in the decisions of other courts.[28] Petitioner cannot conceive on what principles of law or equity its conduct, under such circumstances, would constitute deliberate infringement.

The sole question here can be nothing more than the validity of the attempted restriction (see *Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373, 395). If it is invalid it becomes utterly irrelevant to consider what the Transformer Company or the petitioner knew or intended to do about it. As Judge HOUGH put it at the trial of the *Motion Picture Patents* case (U. S. Supreme Court Record pp. 54-55) 243 U. S. 502:

> "• • • I apprehend that the question here is whether the Prague Amusement Co. could not do exactly what it is accused of having done, no matter how many conversations it had with the Patent Co., or any of its affiliated concerns. • • • *The question is, was it lawful. That is the whole point.*"

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[28] See *Chicago Daily News* v. *Kohler*, 196 N. E. (Ill.) 445, where the Court said (pp. 449-450):

> "Federal decisions denying the right of patent owners, in selling patented articles, to reserve control over the resale or use, do not rest upon any mere question of the form of notice attached to the articles, or the right to control, solely by reference to such notice, but upon the *basic ground that the control of the patent owner over the articles in question ends with the passing of title.*" (Citing the *Bauer, Keeler* and *Boston Store* cases.)

If, as follows from this Court's majority opinion, a patentee, by restrictive license to a manufacturing licensee, and a restrictive "notice" attached to the article when sold, may exercise a control over the *use* to which that article may be put throughout its life, and regardless of in whose hands it may be found, it requires but brief consideration to see the absurd extremes to which patent owners may hereafter go under such a revolutionary and oppressive doctrine. And it requires but little reflection to see at once "the inconvenience and annoyance to the public" that would result, as stated by this Court in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, 667. For example, every patented commodity in everyday use could be "restricted" by the patent owner to particular uses. Fountain pens could be restricted to signing letters; household refrigerators to preserving only specified food-stuffs; automobiles to transporting adults; and other illustrations suggest themselves without limit. To use any of these commodities for any *other* purpose or in any *other* manner would necessitate the purchase of another such commodity expressly licensed for use in that *particular* manner or for that *particular* purpose. Such a result, so absurd on analysis, inevitably flows from the doctrine of this Court's prior decision, in the present case.

It is difficult to conceive of a more drastically oppressive doctrine. And when it is remembered that many, if not most, of the devices used in everyday life—and now regarded as necessities thereto—are patented devices, it will at once be seen that by no more effective means could the public rights be completely surrendered to the patent pool monopolists. Indeed, so appalling are the obvious effects of such a doctrine that even the most fanatic monopolists have not had the temerity to suggest legislation to that effect—and this Court, as above pointed out, has repeatedly

held heretofore that the existing statutes do not permit it. The result is, therefore, that this Court by its prior decision in this case has inadvertently established a doctrine which is not supported by statute, authority, or principle.

What difference in principle is there or can there be between a patentee's attempt to restrict the place of use, the time of use, the materials used therewith, and the resale price of a patented device, on the one hand, and the manner or purpose of use, on the other? This Court has persistently and for nearly a century insistently invalidated all of the first stated restrictions for the reiterated reason that when the device made under the patent is in the hands of a purchaser that device is forever freed from the patent and entirely outside of the patent law. Yet the majority opinion of this Court, without reference to its long line of unbroken decisions on the subject, and without statement or explanation of how there is or can be any distinction between the present case and its prior decisions, sanctions the restrictions on *purpose* or *manner* of use sought to be imposed by respondents in the present case. It is impossible for us to believe that this was the Court's intention, although it is undeniably the result of the outstanding opinion. It is our belief that due to our failure or inability clearly to make and define the issue, this Court, in arriving at the conclusion announced in its majority opinion, failed to comprehend the seriousness and want of justification for the situation which has been created.

In addition, in its majority opinion this Court made error on which its conclusion was based, in part at least, in asserting that petitioner in the present case was

> "not a purchaser in the ordinary channels of trade."

To point out the error it is merely necessary to refer to this Court's prior decision in *Dr. Miles Medical Co.* v. *Park &*

Sons, 220 U. S. 373, 408, as authority for the proposition that *any article sold* becomes

> "an article of commerce and the rules concerning the freedom of trade must be held to apply to it."[29]

Likewise, in two portions of this Court's prior majority opinion in this case it is stated that the amplifiers were not licensed to be sold for any *commercial* use. That is incorrect. An inspection of the license agreement will demonstrate that the purported licensed uses cover the field of "radio broadcast reception", unlimited by express definition to any private or "home" field. (Vol. III, p. 1416, fol. 4248.) Petitioner mentions this because the opinion states, as respondents urged in their brief at the prior hearing, though without support from the record, that respondents reserved the *commercial* field to themselves. What they really sought to do was to license the use of the amplifiers in amateur, experimental and in *certain* commercial fields, and to divide off and reserve *other* commercial fields to themselves and their associates under the radio patent pool agreements (Vol. III, pp. 1305-1413).

Finally, it is believed that it will be apparent to the Court that it fell into the error of its prior majority

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[29] See also *Coca Cola Co.* v. *The State*, 225 S. W. 791, 793, where the Court said, of the status of a patented article after its sale:

> "Having parted with his ownership therein, it enters the channels of trade as an article of commerce, and is thereafter beyond his (the patentee's) control". (Matter in parenthesis ours.)

In *State of Missouri ex rel. B. & O. Tel. Co.* v. *Bell Tel. Co.*, 23 Fed. 539, 540; appeal dismissed 127 U. S. 780; the Court said:

> "There is no peculiar sanctity hovering over or attaching to the ownership of a patent. It is simply a property right to be protected as such. Starting from that as a basis, while every property owner may determine for himself to what he will devote his property, yet the moment he puts that property into * * * the channels of commerce, that moment he subjects that property to the laws which control commercial transactions * * *."

opinion because it overlooked the legal distinction that exists in the relation between *patentee and licensee*, on the one hand, and between *patentee or licensee and a purchaser*, on the other. Where the *first* relationship exists, broad reservations of rights to patentees have been permitted, and are not here questioned. Where the *second* relationship exists, *no reservation by the patentee of any kind or nature whatsoever has ever been permitted.* The exercise of rights permitted to patentees in relation to their licensees rests upon principles utterly apart from those applied by this Court in cases involving the rights of *purchasers* of patented articles. Patentees went to great pains in cases like *United States* v. *General Electric Co.*, 272 U. S. 476, *Bement* v. *National Harrow Co.*, 186 U. S. 70, *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32, to convince this Court that they were not violators of the anti-trust laws because, they argued, the transactions attacked were not *sales* of patented articles, but merely *license* or *agency* agreements which the patent monopoly protected so long as *purchasers* of the patented articles were not involved. This Court agreed with them, though in the *Shoe Machinery* case, the Government made a determined but unsuccessful effort to have the Court hold the leases of machinery to be sales, and because thereof, outside the scope of the patent laws. But never, until the decision of the case at bar (except in the expressly overruled *Dick* case and the cases predicated on the principle there stated), did this or any other Federal Court hold a *purchaser* of a patented article from a patentee or one empowered to sell, to be an infringer for disobeying, *intentionally or otherwise*, restrictive conditions sought to be annexed to the subsequent *use* or *disposition* of the article *in the hands of the buyer*.

It is therefore respectfully submitted and urged that this Court, on being made cognizant of the foregoing impelling and controlling factors which were undoubtedly overlooked in formulating its prior decision, and on realizing the unintended, radical and far reaching effect as well as the untenable character thereof, should overrule its prior decision, and bring its conclusions in the present case in harmony with the law that has been established and followed by this Court for nearly a century.

Conclusion.

In conclusion it is submitted:

1. Petitioner, by its use of amplifiers purchased from a licensee of respondents, licensed to make and sell the amplifiers, did not and could not infringe the patents under which, concededly, the amplifiers were manufactured and sold. Therefore, petitioner is not guilty of infringement as charged in the bill of complaint.

2. The "license notice" attached to the amplifiers sold to petitioner purporting to restrict the use to which the amplifiers might be put, was neither valid nor enforceable; and petitioner's use of the amplifiers outside of the restriction specified in the said "license notice" did not, as a matter of law, make such use an infringement of the patents in suit.

In consequence, the prior majority opinion of this Court in this case was in error and should be corrected. Likewise, the decision of the Court of Appeals below was in error, and, upon the foregoing grounds, that Court should be

reversed and the cause remanded to the District Court for the Southern District of New York with instructions to dismiss the bill of complaint.

Respectfully submitted,

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Counsel for Petitioner.

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JOSEPH J. ZEIGER,
Of Counsel.

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IN THE

Supreme Court of the United States

October Term, 1938

No. 1

(No. 387, October Term, 1937, On Rehearing)

Columbia Talking Pictures Corporation,

Petitioner,

vs.

Western Electric Company, Inc., Electrical Research Products, Inc., and Associated Theatres Apparatus Corporation,

Respondents.

REPLY BRIEF FOR PETITIONER

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IN THE

Supreme Court of the United States

October Term, 1938

No. 1

(No. 357, October Term, 1937, On Rehearing)

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

REPLY BRIEF FOR PETITIONER.

Respondents have reprinted, for use on rehearing, Part of their original brief in this cause. Our reply thereto, substantially as contained in our original reply brief, is appended hereto as an appendix.

Respondents have likewise filed a "Memorandum" on rehearing. To this we make immediate reply.

I.

Apparently respondents' main effort is directed to avoiding the issues presented by the two questions on which the rehearing was ordered. It is asserted (pp. 2-3) that "these questions are not involved in this case" because,

respondents state, the sales of the amplifiers to petitioner were "infringing sales", beyond the scope of the vendor's license and therefore not "under the patents".

In the first place it must be self evident that such assertions do not remove the necessity for considering whether, indeed, as a matter of patent law, and wholly apart from the verbiage of the license agreement between respondents and the Transformer Company, the sales to petitioner were or were not "infringing sales", or "beyond the scope" of the license or "under the patents". Every patent infringement case which has been before this Court, involving attempted restrictions on patented articles in the hands of purchasers was predicated on the charge that the sale was beyond the scope of the license of the seller, and hence an infringement and not a sale under the patents. Yet in each of those cases [1] this Court first considered the validity of the attempted restriction as against *purchasers* from those having a power of sale (restricted though it purported to be) and holding such restrictions invalid *under the patent law*, swept aside the charge that the sales were not under the patents and beyond the scope of the license.

Thus, in *Adams* v. *Burke* (84 U. S. 453), the territorial assignee's rights were expressly limited to a certain territory. He sold the patented device for use in a different territory,—one in which he had no rights. There, as here, the patentee sued the purchaser, *claiming that the vendor made a prohibited, infringing sale, i. e.* not under the patent. This Court held that the patent law countenances no such prohibitions against patented articles upon their sale, and dismissed the bill against a dissent [2] which advanced precisely the same contention that respondents make here.

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[1] See our main brief on rehearing pp. 10-26.
[2] See our main brief on rehearing p. 35.

In the later case of *Hobbie* v. *Jennison* (149 U. S. 355), the same contention was again made, but this time against the territorial assignee, *the manufacturing vendor himself*. Indeed, as the patentee argued (pp. 359-60), in a vain attempt to weaken the effect of *Adams* v. *Burke*,—"* * * In the present case the *lawfulness*[3] * * * of the alleged sale * * * is exactly what is contested * * * the claim of the plaintiffs being that such sale and the shipments thereunder expressly for use within the territory of the plaintiffs constituted an invasion upon the rights of the plaintiffs and as against them were unlawful." But this Court held the sale to be valid under the patent on the doctrine of *Adams* v. *Burke*.

Likewise, in *Keeler* v. *Standard Folding Bed Company* (157 U. S. 659), an infringement suit against a *dealer*, precisely the same situation was presented and the same contention rejected as against a dissent which viewed the vendor territorial assignees who sold the patented devices to this dealer for use in a territory in which they had no rights, as infringers in making the sales.

Moreover, in all the cases involving attempted restrictions on resale price or use,[4] the same argument was again unsuccessfully made by the respective patentees, namely, that inasmuch as the licensee exceeded the scope of his license, the sale or lease by the licensee, who in each instance had a power of sale, was an infringing sale or lease.

So, in *Bauer* v. *O'Donnell* (229 U. S. 1), the patentees in their brief argued, as respondents do here, that the retailer, by purchasing with notice, "was bound by such conditions,

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[3] Italics ours unless otherwise stated.

[4] *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor Talking Machine Company*, 243 U. S. 490; *Boston Store* v. *American Graphophone Company*, 246 U. S. 8; *Motion Picture Patents Company* v. *Universal Film Manufacturing Company*, 243 U. S. 502.

the conditions being a *limitation* of the grant of a license to sell the package,"[5] and vainly tried to distinguish *Adams* v. *Burke* and the *Keeler* case on the theory, also advanced by respondents here, that those cases involved unrestricted, unconditional sales, while the *Bauer* case presented express conditions and limitations. Yet this Court refused to consider any such contention, and dismissed the bill on the one ground, expressed in all the other cases upon which we have relied, that the sale of a patented article by one having the power of sale, even though that power is, by agreement, restricted, exhausts the monopoly as to that article in the hands of the purchaser, and forever frees it from the patent.

Similarly, in *Straus* v. *Victor* (243 U. S. 490), it was charged that the retailer who purchased the patented devices from the distributor-licensees of the patentee, "* * * having covertly obtained possession of the physical thing and the *limited* license to use it without having paid" the required price, had "as a condition precedent acquired *no lawful* right of possession." * * ** Here, too, this Court swept this contention aside and decided the question on the ground that a sale of a patented device ends the control of the patent thereon.

Finally, in *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8; and in *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502, patentees were again defeated in their attempts to enforce restrictions on patented articles after their sale. Indeed, in the *Boston Store* case, the patentee argued that "* * * complainants are not relying upon a 'mere notice' attached to the patented articles * * *," but "upon a direct and express restrictive agreement between the patentee, and his immediate licensee-vendee

[5] P. 6 patentee's brief in Record, 229 U. S. 1.
[6] P. 14 of patentee's brief in Record, 243 U. S. 490.

* * *."[7] And in the *Motion Picture Patents* case, where the license agreement under which the patented device was made and sold, closely parallel the one at bar, it was also contended by the patent owner that "there was no *unqualified* sale of the patented machine for use without restriction".[8] Yet in both cases this Court brushed aside all questions of restrictive *agreement* on scope of license and decided the cases squarely on the ground that the restrictions sought to be imposed find no recognition in the patent law, whatever might be the remedy in contract.[9]

Thus, it will be seen that there is no merit whatever to respondents' basis for avoidance of the issues here presented; but their effort to do so speaks eloquently of their realization of their inability to sustain the erroneous judgment of the Court of Appeals below on the merits.

As we have stated in our main brief on rehearing, the "fundamental ground" on which all of the cited decisions of this Court has been predicated is that when a sale of a patented article has been made by one having the power to sell, that article is forever outside of the monopoly of the patent regardless of any contractual restriction that might exist on the power to sell. The application of that "fundamental ground" to the present case is obvious. The licensed vendor, American Transformer Company, was unquestionably empowered to make and sell. Although, as a matter of verbiage in its license contract it was empowered to sell only for specifically restricted purposes, *all that it was required to do under the contract was to attach the prescribed notice of restricted license to the apparatus it sold.* It was so understood and the agreement itself so expressly

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[7] P. 48 of patentee's brief in Record, 246 U. S. 8.

[8] P. 22 of patentee's brief in Record, 243 U. S. 502.

[9] *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502, 509.

provided.[10] When that was done by the vending licensee, its contractual obligations were completed, *title* passed, and any apparatus sold by the licensee with that notice attached inevitably and unavoidably became sales "under the patents".

II.

We asserted in our main brief on rehearing[11] that the primary issue in these cases is not *knowledge* or *intention*. The sole question is addressed to the validity of the attempted restriction. If it is invalid under the patent law, the patent law excises the limitation and leaves the purchaser of the article sought to be restricted, free to do with it as he wills. A patentee, therefore, cannot be heard to say that his licensee, who is empowered to make and sell the device, makes an infringing sale, and that the purchaser is a deliberate infringer, when both vendor and vendee and their respective counsel honestly believe, and have every reason to believe, that such attempted restrictions on patented articles after their sale have, for almost a century, been held *invalid* by this Court. We have therefore asserted[12] that as a matter of law it was wholly immaterial whether or not a vendor, licensed to sell by the patent owner, *knew* that the purchaser was going to violate a purported restriction on the use of the patented device in the purchaser's hands, or *intended* that the purchaser should do so. The basis for our assertion was the express state-

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[10] In a letter to petitioner, the Transformer Co. wrote: "That is the type of license notice which is placed upon the amplifier and that is the only way which we can sell them" (Vol. II, p. 732, fol. 2195). See also par. 5 of the license agreement (Vol. III, p. 1418, fols. 4253-4254).

[11] Petitioner's Main Brief on Rehearing (pp. 41-43).

[12] See our main brief on rehearing (pp. 10-26).

ment of this Court in *Hobbie* v. *Jennison*, 149 U. S. 355, 363, that in a case involving these identical issues, *neither knowledge nor intent was material.* Respondents seek to avoid the implication of that decision, and the subsequent decisions of this Court based thereon, by citing (p. 7) a number of cases involving *contributory* infringement where it was held, and quite properly so, that intent is a necessary element of *contributory* infringement. But the case at bar is not one involving contributory infringement. Direct infringement is charged, and the doctrine of the *contributory* infringement cases has not even a remote bearing on the point here at issue.

But respondents proceed from that point to the assertion that not only was there knowledge and intent in the present case, but there was connivance between petitioner and the American Transformer Company as well. It is asserted that the mere fact that both of those concerns consulted counsel—"leaves no room for doubt that both of them were cognizant of every pertinent fact" at the time the amplifiers were sold. This assertion of respondents seems to us to imply that petitioner here contends, or has contended in the Courts below, that it had no knowledge of the restrictive notice. No such contention has ever been made. Petitioner *did* have knowledge of the restrictive notice on the apparatus—in fact that notice was attached to every piece of apparatus sold to petitioner. But petitioner's counsel advised that the restriction attempted by the license notice was invalid and unenforceable, and that this Court had repeatedly so held with respect to attempted restrictions of similar character. Apparently counsel for the American Transformer Company reached the same conclusion for its sales were permitted by its counsel. This, then, is what constituted the basis for respondents' assertions of connivance and infringement.

It seems to us, however, that it is the respondents' knowledge and the respondents' conduct that cannot bear scrutiny. The very tenor of the license agreements they made with the Transformer Company and others for the making and sale of the amplifiers[13] and their conduct with respect to petitioner and the Transformer Company over a period of more than two years during which these sales were being made with full knowledge of respondents,[14] indicate most clearly a desire for extensive royalties by the wider market that comes with *sales* rather than simple *licenses* or *leases* to users; and an intention to rely on the efficacy of "license notice" restrictions alone, as attached to the articles. That is the tenor of the licensors' instructions on inquiry from the Transformer Company, written long before any transactions with petitioner.[15] That furnishes the sole logical and intelligible explanation why respondents, during the two years they concededly knew of the sales being made to petitioner by the Transformer Company, never protested; never returned the royalties they received on these very sales until more than a year after this action was commenced; never sued the Transformer Company for any breach of the license agreement; never cancelled it; and permitted it to run until its natural expiration.[16] If those sales were "outside the scope of its license", as the majority opinion holds, a simple notice of cancellation would have effectually put an end to it.

Yet respondents' final plea is predicated upon the statement that they have received no benefit by way of royalties

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[13] Vol. I, pp. 332-335; Vol. III, pp. 1414-1423.
[14] Vol. III, pp. 1568-1614.
[15] Vol. II, p. 1214, fol. 3642.
[16] Vol. I, pp. 344, 349, 468; Vol. II, p. 1216; Vol. III, pp. 1568-1614.

from the sales made to petitioner (Memor. pp. 8 and 9). We regard this as an audacious statement in view of the fact that it is predicated upon a footnote (p. 9) to the effect that.

> "royalties initially paid upon its sales by the Transformer Company were returned to that company by respondent's agent after the identity of the purchaser had been ascertained and were accepted by the Transformer Company".

Although the facts pertaining to this phase of the case formed Point III of our brief at the main hearing, and on which no rehearing was granted, the utilization of this statement by respondents in support of their contentions now before the Court makes it necessary for us to point out that although the sales to petitioner were continuous from February 1929, until one month before the Transformer Company license expired in August 1931, and were reported by the American Transformer Company quarterly thereafter as required by its license contract, *the royalties were not refunded until December 18, 1930—more than a year after the present suit was filed by respondents.* Indeed, at pages 68-69 of respondents' brief at the main hearing, it is admitted that they knowingly retained the royalties after the suit was filed. These simple facts completely refute the implication from Footnote 8 at the bottom of page 9 of their brief that the royalties initially paid were returned as soon as the identity of the purchaser had been ascertained.

Here, again, the return of the royalties was an afterthought that occurred more than a year after the filing of the suit. Surely, it took respondents a long time to become reconciled to being deprived of the "benefit from the sales by way of royalties".

We believe respondents have brought themselves squarely within the criticism voiced by this Court in the *Keystone Driller Company* case.[17]

> "It is a principle in chancery, that he who seeks relief must have acted in good faith. The equitable powers of this Court can never be exerted in behalf of one who has acted fraudulently or who by deceit or any unfair means has gained an advantage. To aid a party in such a case would make this Court the abetter of inequity."

III.

Respondents, in what we regard as a desperate attempt to bolster their position in this case, next, for the first time in the history of this litigation—for the first time in this or any of the Courts below—seek to convey the idea that the amplifying apparatus, which forms the subject matter of the suit, is *specially* designed so as to be useful *only* with talking motion picture equipment (Brief, p. 6; footnote p. 14). This is an amazing assertion for respondents to make, in view of the fact that it is not only flatly contradicted by the record, but is contrary to every assertion that has been made to the Courts below and to this Court on the prior argument, as well as contrary to the f[redacted]. We turn to page 194 of Volume I of the Record, to which respondents direct attention in support of their assertion and we find that respondents' expert witness was specifically asked (fol. 580) whether or not the defendant's amplifier could be used for any one of a number of purposes, namely in connection with wireless telephony, wire telephony, public audition systems, and sound systems, to which he answered (fol. 581):

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[17] *Keystone Driller Co.* v. *General Excavating Co.*, 290 U. S. 240, 245, quoting from *Bein* v. *Heath*, 6 How. 228, 247.

> "Broadly speaking, I should think that the propositions may be assented to."

Again, respondents' witness Wilcox (Vice-President of respondent, Electrical Research Products, Inc.) stated (R. p. 500, fol. 1499):

> "The Western Electric Company amplifiers were used in public address systems in 1920 in connection with the Harding inaugural. Our company uses its amplifiers for public address systems now. Some of the phonograph companies acquire licenses for electric recording and electric reproducing—the Victor Talking Machine Company and the Columbia Phonograph Company in this country."

Again, Otto S. Schairer (Vice-President of Radio Corporation of America)—one of the companies associated with respondents in the radio patent pool—after enumerating the various "fields" in which his company was interested, including communications from tolls, amateur, experimental and broadcast reception, stated (fol. 1548):

> "These things, these vacuum tubes, and the circuits on which we have patents, are useful in various of these fields and applicable to many fields."

Finally, we call attention to the admission in respondents' original brief (and its reprint—p. 8) wherein the statement is made:

> "The facts are these. Amplifiers embodying the inventions of the patents here involved are useful in various fields including the *commercial* field of sound recording and reproducing, which embraces talking picture equipment for theaters and the *private* or *home* fields, which embraces radio reception, radio amateur reception and radio experimental reception (italics their's)."

From this it will be seen that this attempt to convey the idea that the apparatus here involved is not a standard article or commerce which can be used for any one of a number of different purposes for which amplifiers are made, sold and universally used, is an eleventh hour effort, born of desperation and founded on anything but the fact. It is of course true, but in a very limited sense, that some "adaptation" is necessary for any piece of apparatus to use it in any particular environment, just as a suit of clothes must be fitted to its wearer. And it may readily be admitted that when amplifiers are used with talking motion picture equipment, additional equipment, such as a photo-electric cell, a projecting machine, an arc lamp, etc., must be supplied. But these are not additions to the *amplifier* any more than the detector and loud speaker are additions to the same *amplifier* when used in a radio broadcast receiver. The simple fact is—and although this assertion has been made throughout this litigation and has never until now been questioned, and cannot now be successfully questioned—the *amplifiers*, as sold defendant, could have been used, without alteration for any one of the many purposes for which *amplifiers* are universally used. Indeed, in view of the testimony of respondents' own expert, above quoted, it will be readily appreciated why this association has never heretofore been questioned.

IV.

Respondents characterize as "fantastic" the few simple illustrations we gave in our main brief of the inevitable consequences of the first decision of this Court in this cause, if allowed to stand. That is indeed a weak answer to a proposition which is otherwise unanswerable. The very fact that it is characterized by respondents as "fantastic"

is sufficient basis to warrant avoiding setting up any doctrine which would stamp with legality what on its face is not only possible but is inevitably probable. On the other hand, we fail to see anything fantastic in the illustrations. The sole purpose of the doctrine respondents are seeking to establish is to permit them to compel the public to purchase identical instruments for different uses. More than that, as frankly admitted by Schairer, the Vice-President of the Radio Corporation of America (R. pp. 515, 516), it is intended to make people in different fields pay enormously higher tribute to the patent for use of the identical apparatus they may purchase. If such a doctrine has the stamp of approval of this Court, the actual putting in force thereof by these respondents either alone or with their associates in the patent pool, will make these so-called "fantastic" illustrations quite mild as compared to what the public will be subjected to in consequence.

Apparently realizing the weakness of their answer to these illustrations, respondents seek to differentiate the illustrations from the situation here presented by pointing out that there were no different "fields" involved in the illustrations, whereas here different "fields" of operations are involved. Wholly aside from the fact that this does not *legally* distinguish between the two situations, it requires but little imagination and no ingenuity to modify the same illustrations to make them identical with the case at bar as to "fields" of operation. Thus, the fountain pen is sold with a notice attached that it is limited only for writing—the literary field—and the owner thereof, if he desires to draw pen and ink pictures—the artistic field—would have to purchase another fountain pen permitting use in that field. Similarly, one who owned an iron sold with a notice attached that it could be used only for ironing shirts, collars, etc.—

the laundry field—would have to acquire an identical iron licensed for use to press trousers—the clothing or tailoring field. Again, an owner of a refrigerator with a notice thereon that it was licensed only for use in preserving foodstuffs—the household field—would be required to buy another refrigerator licensed for such use to preserve medicines—the medical field. As in the illustrations originally given, countless additional illustrations of separate "fields" readily suggest themselves.

V.

In conclusion, we repeat the comment made in our Petition for Rehearing, that, contrary to the view of respondents as expressed in their brief on rehearing (pp. 11-12), this Court's prior opinion not only is not in "strict accordance with the authorities" as respondents assert, but in truth is wholly contrary to every decision (except for the *Dick* case) this Court has ever had occasion to make with respect to the rights of purchasers of patented articles from one having a power of sale. None of the authorities cited by this Court in support of its prior ruling in this cause, with but one or two minor and irrelevant exceptions, deals with the rights of purchasers of patented devices. Those authorities, including the references to Robinson on Patents, refer only to the relations between patentee and licensee, and the broad reservations of rights permitted to patentees. No clearer picture of this differentiation can be had than by reference to the dissenting opinion in the *Dick* case, where *Mitchell* v. *Hawley*[18] relied on by this Court in the case at bar, and by the majority in that decision, was distinguished from cases like *Keeler* v. *Standard Folding*

[18] *Mitchell* v. *Hawley*, 11 Fed. Cases 883 at 885, aff'd 16 Wall. 544.

Bed Co., and the long line of similar authorities relied on by petitioner, as relating solely to a license where the right conferred by the patentee was merely a right to make and use, *with the right to sell entirely reserved* (224 U. S. 1, 63-64).[19] That right to sell was undeniably granted to the licensee in the case at bar, freeing the amplifiers purchased by petitioner from the restrictive conditions which this Court, until this case, has in such instances always held unenforceable under the patent law.

It is respectfully submitted, therefore, that if the decision remains unaltered it will not only offer to those so disposed an avenue of escape from the prohibitions of the anti-trust laws, but will again unsettle and surround with doubt the question as to the limits of the patent grant with respect to the rights of purchasers of patented articles, which, until this decision, were put at rest by a progressive and consistent series of decisions culminating and reviewed in the *Boston Store* and first *Shoe Machinery* cases.[20] We are confident that no such result was intended, and that, upon the present consideration of the case the judgment of the Court of Appeals for the Second Circuit will be reversed.

Respectfully submitted,

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Counsel for Petitioner.

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JOSEPH J. ZEIGER,
Of Counsel.

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[19] The District Court in *Mitchell* v. *Hawley*, 1 Holmes 42, 44, aff'd by this Court in 16 Wall. 544, held that

> "Nothing can be more evident than the purpose expressed in this instrument, to put it out of the *power* of Bayley to give any title to the machines. The very act of sale was a violation of the contract and an act of infringement." (Italics by the Court.)

[20] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32.

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APPENDIX

Reprinted Reply Brief for Petitioner

(In reply to Part I of Respondent's Original Brief, reprinted for use on rehearing)

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IN THE

Supreme Court of the United States

October Term, 1937

No. 357

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

REPLY BRIEF FOR PETITIONER.

It is asserted by respondents, and repeated throughout their brief, that they are actuated by a desire to benefit the public and to stimulate trade in seeking to enforce "license notice" restrictions against purchasers of articles made and sold under their patents (Resp. brief, pp. 23-25). Indeed, respondents say that the purpose underlying the formation of the patent pool, commonly known as the "Radio Trust" (Petr. brief, p. 4), was "to make fully available to the public the great benefits of the new art. • • •" (Resp. brief, p. 58).

If this somewhat naïve expression of motive by one of the largest industrial monopolies in the world is to be taken

at face value it would seem difficult to explain (1) why respondents were prosecuted in 1930 under the Anti-Trust laws on this very patent pool and, to obtain a dismissal, were compelled to modify the agreement so as to eliminate the exclusive license feature therein (Vol. I, fols. 1556, 1562-1563; Vol. II, pp. 798-799); and (2) why respondents were adjudged to have violated the Anti-Trust laws in connection with their domination of the talking motion picture industry.[1]

In truth, therefore, if deeds control and not protestations of high motive, respondents' sole purpose in annexing "license notice" restrictions to articles made and sold by their licensees (instead of trying the simple method of contracts with purchasers, of which they were well aware and which they utilized on other occasions[2]), must have been to enlarge the field of their recognized commercial monopoly by obtaining, as they hoped, an additional weapon in the guise of an infringement suit under the patent law. This, indeed, being the real aim of respondents,—so obviously subversive of the public interest,—it is not surprising that their brief endeavors, by subdividing its argument under various sub-titles, to becloud the simple issues here presented and to divert the argument to matters with which this case, a patent infringement suit, is not concerned.

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[1] *Stanley Co. of America, Inc.* v. *American Tel. & Tel. Co., et al; General Talking Pictures* v. *American Tel. & Tel. Co., et al; Duovac Radio Corporation* v. *American Tel. & Tel. Co., et al;* 4 Fed. Supp. 80; on final hearing 18 Fed. Supp. 650. Respondents' assertions with respect to these cases (note 5, p. 60 their brief) are erroneous. On request of their counsel in that litigation the case has now been set for the March Term of the Circuit Court of Appeals for the Third Circuit, and they, as well as the petitioner, are appellants therein.

[2] *Radio Corporation of America* v. *DeForest Radio & Telegraph Co.*, 97 N. J. Eq. 37 (1925); *infra* p. 11.

We refuse to be drawn into argument on irrelevant issues and adhere to the propositions which are advanced in our main brief: (1) Can the owner of a patent, by *an infringement suit under the patent law,*[2] restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade? (2) Can such restriction be effective under the patent law merely by a "license notice" attached to the device sold?

If the answer to either of these questions is—"No"—and that has been the answer of this Court for almost a hundred years—then the "scope" of the license possessed by the manufacturing licensee, to a consideration of which respondents expend their greatest effort, becomes wholly irrelevant to the case. If we read the decisions of this Court correctly, from the standpoint of *infringement*—the remedy here invoked,—once the *power to sell* is given, any such "license notice" restrictions are beyond the pale of the patent monopoly.

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[2] Italics in this brief ours, unless otherwise stated.

Replying to Part I of Respondents' Brief on the defense of purchase from a licensee empowered to make and sell.

As to the contention that the sales to petitioner were outside of the license of the American Transformer Company.[1]

Respondents apparently place their main reliance on the assertion that in as much as the American Transformer Company was licensed to manufacture and sell the amplifiers under dispute only for certain specified uses to be set forth on "license notices" attached to the amplifiers upon their sale, that the licensee's sales with knowledge that other uses for the amplifiers were contemplated, made such sales *"in infringement of the patents"* and not *"under the patents."* On this assertion respondents build a most elaborate and extended argument. The want of merit in the contention and in the argument built thereon becomes apparent on but a moment's reflection.

In the first place, it emphasizes the fact that the distinction respondents seek to draw between the two conditions is not made to depend on any act of the licensee. The Transformer Company had the right to sell, and it would exercise that right in both instances in the identical manner and in every respect, viz.: by attaching the "license notice" as directed by the agreement. The ultimate determination of whether or not any particular sale would constitute a sale "in infringement of the patents" or a sale "under the patents," as contended by respondents, would depend *not* upon any act of the licensee but solely upon some subsequent act

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[1] Respondents' brief, pp. 8-20.

of the *purchaser*. Very clearly the licensee was not required, nor would he be permitted by law, to police the purchaser's place of business in order to see that the purported "license notice" limitation on use was observed. The situation can be made very clear by a simple illustration. Let us assume that someone purchased an amplifier from the Transformer Company and told the Company at that time that it was to be used for radio broadcast reception (one of the alleged licensed uses). According to respondents' arguments, that would have constituted a proper sale "*under* the patents". Obviously, if the purchaser subsequent to his acquisition of the amplifier, proceeded to use it with motion picture equipment, that fact would not in any respect affect or alter the validity of the sale by the Transformer Company. Take the converse. Assume that this individual told the Transformer Company at the time of the purchase that he intended to use the amplifier in connection with motion picture equipment, and nevertheless the Transformer Company made the sale, and the purchaser subsequently did not use the amplifier with motion picture equipment, but, on the contrary, used it exclusively for radio broadcast reception. Under the respondents' argument that likewise would have constituted a legitimate sale "under the patents" because of its subsequent legitimate use.

These illustrations fittingly show, therefore, that the ultimate determination, under respondents' argument of whether or not the amplifier made and sold by one licensed to do so was within or without the purported restrictions of the "license" was dependent in no respect upon any action of the licensee, but solely upon the use to which the ultimate purchaser put the amplifier thereafter. It is clear, therefore, that "knowledge" on the part of the selling licensee has nothing whatever to do with the legal principles here

involved, and, at best, merely represents a mental attitude of no legal consequences. In other words, if the "license notice" were legally effective to bar other uses, the knowledge of the licensee that a purchaser intended not to abide by it would surely not destroy that effectiveness.

As a final illustration we present the third possible situation,—namely, where the purchaser acquires the amplifier from the American Transformer Company without being asked and without stating for what use it was to be put. Here, again, under respondents' argument, the sale would be proper as "under the patents", and here, again, according to respondents, an infringement of the patents could occur only depending upon the particular use to which the amplifier was to be put by the purchaser. This last example conclusively demonstrates that the only obligation assumed by the selling licensee with respect to the restriction on use which respondents here endeavor to foist upon the public, was the attachment of the alleged "license notice" to the amplifier when sold. The licensee performed its contract by affixing that "license notice" and thereby used the very means directed by the patentee to accomplish that result. What we have here said is, moreover, in strict accord with the ordinary rules governing the interpretation of contracts, and license agreements are contracts subject to those rules (*Wetherill* v. *Passaic*, Fed. Cas. #17,465; 6 Fisher 50 (1872)).

The practical construction put upon the agreement by the parties accords with the foregoing view. At page 10, note 1 of their brief, respondents quote a letter from their licensee to petitioner in November, 1928, in which the licensee plainly states that: "The only way which we can sell them" (the amplifiers) is by placing the license notice on the machines. At an earlier date, in September, 1927

(Vol. II, fol. 3642), the licensor wrote to the licensee in response to its inquiry with respect to the license notice restrictions that: "The net result of this is that if *anyone buys* a power supply or amplifier unit from you he may use it for a radio receiving set but he cannot use it for an electric phonograph, etc. * * *". This construction of the contract as given to the licensee is a clear indication that the sole concern of the licensor was the use of the article subsequent to its sale.

In this connection it is significant, as bearing on respondents' insincerity, that although the alleged infringement is based on the purported lack of authority of the licensee to make the sales it did make to the petitioner, that authority was never questioned by the patentee in any action either to cancel the Transformer Company's license or for infringement, or for damages for alleged breach of any covenant therein. Indeed, that license was permitted to run to its natural expiration. The Transformer Company was permitted to continue to make sales of the amplifiers to the petitioner long after this suit was instituted, and the royalties paid by the Transformer Company on these sales were retained for over a year after the commencement of this action. For respondents, then, to insinuate, as they do in various portions of the brief, that petitioner "connived" or "conspired" with the Transformer Company in purchasing these amplifiers, with no charge of that character ever having been made either in the pleadings or at the trial or on appeal, and with no finding whatsoever to that effect, is, apart from the inherent impropriety of such implications, an interesting commentary on the methods pursued by respondents in seeking to attain their ends.

Stripped of the verbiage and misinterpretation and misapplication of the authorities, the present effort of respon-

dents consists merely of an attempt to extend control by means of their patents over devices manufactured and sold under their patents after reaching the public in the ordinary channels of trade. The same efforts were made, and the same arguments advanced, time and time again, but only to meet defeat in this Court. We will not unduly extend this reply by renewed consideration of the authorities on this phase of the controversy which are fully discussed in petitioner's brief (pp. 34-39), but cannot pass without observation what must be respondents' deliberate beclouding of the issue by a misstatement of the facts and the law of *Mitchell* v. *Hawley*, 11 Fed. Cas. 883, affirmed 16 Wall. 544, upon which they rely.

Though respondents deal with *Mitchell* v *Hawley* at pages 16-19, and 29-31 of their brief, they nowhere say, what could have been easily gleaned from a reading of the case, that what Bayley, the licensee, there received was merely the grant of an exclusive *license to make and use* for a specified territory and for the remainder of the original patent term, *with no power of sale whatsoever.* (*Adams* v. *Burke*, 17 Wall. 453; *U. S.* v. *General Electric Co.*, 272 U. S. 476; 48 C. J., Section 408, p. 263). We look in vain throughout respondents' brief for that simple statement of fact. It is *that* distinction which runs throughout the cases and which respondents for some reason preferred not to observe. As the Circuit Court pointed out in the *Mitchell* case, in construing the contract that Bayley received (11 Fed. Cas. 883, 885):

> "An examination of this contract shows clearly that it was carefully drawn by the parties to guard against such a result. Nothing can be more evident than the purpose expressed in this instrument to put it out of the *power* of Bayley to give any title to the machines.

> The very act of sale was a violation of the contract and an act of infringement. * * *" (Italics by the Court.)

Clearly, therefore, if Bayley had received the power of sale he would have had powers enjoyed by a territorial assignee. There is no distinction to be drawn in this connection for the determination of the questions here involved between licensees with a power of sale and territorial assignees with a power of sale. They have one thing in common and that is the power of sale. Once that power is present and patented articles are sold thereunder, the purchaser takes free of any restrictions which the patentee may seek to impose under the patent law on patented articles after their sale, the patentee being relegated to the common law either to make or enforce whatever contractual obligations or conditions he may seek to impose on any of the parties to the transaction. That is precisely what this Court pointed out in *Mitchell* v. *Hawley* and it was so understood in its later decisions (*Adams* v. *Burke*, 17 Wall. 453; *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659; *U. S.* v. *General Electric*, 272 U. S. 476). Indeed, this Court in the *Keeler* case expressly refused to extend the doctrine of *Mitchell* v. *Hawley* to cover a case where there has been a sale by the patent owner or by one authorized by him to sell.

As to the public policy argument.[1]

Respondents assert that the public interest actually requires the enforcement of "license notice" restrictions on patented articles after their sale as against the purchasers owning those articles in order that "the public may acquire such devices freely" (Resp. brief, p. 24). This apparently

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[1] Respondents' brief, pages 23-25; 57-61.

innocuous statement takes on added significance when it is recalled that respondents, a powerful public utility, operate as well in other fields such as the talking motion picture industry in which they and petitioner are competitors, and that respondents, even during the period of time involved in the case at bar, have twice run afoul of the Anti-Trust laws.[1]

Respondents plead ignorance[2] of how they could accomplish the beneficent purpose of spreading their inventions throughout the country in the form of articles made under their patents, unless it be through the device of such "license notice" restrictions. However, nowhere in their brief do we find any recognition of the fact that there may be an entirely legal way under the common law by which the use of a patented device can be restricted after its sale, and that is, by a contract entered into between the seller—whether it be the patent owner or his licensee—and the purchaser (provided, of course, that such agreement is not otherwise violative of law). Not only was this method of effecting a restriction on use by contract known to respondents, but it was actually adopted and used by them in other instances (*Radio Corporation of America* v. *DeForest Telephone & Telegraph Co.*, 97 N. J. Eq. 37). However, neither respondents nor their associates in the so-called "Radio Trust" wanted to utilize that method in the present instance. To the contrary, they desired to establish a large number of manufacturing licensees from whom they could, and in fact have, collected annually millions of dollars as royalties—a matter of common knowledge. To accomplish this, obviously no impediment of sales was desirable. Free sales in large quantities was the objec-

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[1] *Supra*, page 2.

[2] Respondents' brief, pp. 24; 55; 61.

tive. Conditional sales contracts, therefore, not only would impede the sales of the manufacturing licensees but also would have centered public and Congressional attention on such a vicious monopolistic practice of the "Radio Trust", the legality of the formation of which was anticipated would be, and in fact has been, attacked both by private interests and by the Government.[1] Therefore the effort was made by respondents to attain this result, viz.: a restriction on use on devices duly sold on the open market,—by the illegal method of attempting to extend the patent laws to do so.

Nor can respondents find support in the cases they cite in support of a purported public policy which would favor "license notice" restrictions under the patent law against purchasers of patented articles. The authorities to which they refer deal simply with the relations between licensor and licensee, with no purchaser of a patented article involved, or with cases arising under the general law in actions in equity.

So, in *Bement* v. *National Harrow Co.*, 186 U. S. 70, quoted at pages 25 and 57 of respondents' brief, the Court was concerned simply with an attempt in an ordinary action in equity to enforce covenants entered into in an agreement between a licensor and a licensee relating to certain patents therein mentioned. The case reached this Court on the charge that the contract involved a violation of the Anti-Trust laws and served as one of the precedents in *U. S.* v. *General Electric Co.*, 272 U. S. 476 in which this Court again held that in an action between the licensor and the licensee alone limitations would be enforced that would have no legal effect if the rights of purchasers of patented articles

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[1] *Radio Corporation* v. *Lord*, 28 Fed. (2) 257, affirming 24 Fed. (2) 565; cert. denied 278 U. S. 648; on final hearing 35 Fed. (2) 962, affirmed in 47 Fed. (2) 606; cert. denied 283 U. S. 847.

had intervened. (See also the dissenting opinion in *Henry* v. *Dick*, 224 U. S. 61.)

In *Fred Waring* v. *WDAS Broadcasting Station, Inc.*, 35 U. S. Patent Quarterly 272 (Resp. brief, p. 61), and in *Waterson* v. *Irving Trust Co.*, 48 Fed. (2) 704 (Resp. brief, p. 63) no questions under the patent law were involved. They were both actions in equity under the general law and dealt simply with what have been occasionally recognized as exceptions to the general rule at common law that servitudes will not run with chattels after their sale. The exceptions in these cases were the protection of the right of privacy on the one hand, and the enforcement of a covenant to work a copyright on the other. Concededly, these cases can have no application to the case at bar which is concerned solely with an attempt to extend the statutory monopoly of a patent beyond the right granted by that statute.

The "general rule" upon which respondents rely.[1]

We suppose it a proper inference from respondents' sub-titles, viz. (1) "the general rule as stated by the authorities"; (2) "decisions applying the rule to restrictions upon the use of the patented device itself"; (3) "decisions of this Court establishing exceptions to the general rule"; (4) "the restriction in the instant case comes under the general rule and is enforceable";—that respondents are referring to some general rule of the patent law permitting restrictions to be enforced against purchasers of patented articles by means of a "license notice" device. There is no such rule; there are no authorities supporting it, nor decisions of this Court establishing exceptions to the rule, nor is the restriction in the instant case within any such supposed general

[1] Respondents' brief, pp. 26-37.

rule. Indeed, respondents have constructed an edifice of unrealities.

Respondents predicate their whole argument as to the existence of this "rule", on *Bement* v. *National Harrow Co.*, 186 U. S. 70, which they quote immediately before entering upon a discussion of the question. As has been hereinabove observed,[1] that case dealt solely with the contract rights and obligations subsisting between licensor and licensee as the immediate parties thereto. The license sustained in the *Bement* case prohibited the licensee from selling at a lower price or on more favorable terms of payment and delivery to the purchasers than was set forth in a schedule attached to the license. These restrictions, of course, applied only as between the licensor and the licensee, and, as this Court said in that case, at page 93 of its opinion:

> "The provision in regard to the price at which the *licensee would sell* the article manufactured under the license was also a proper and reasonable condition. * * * The owner of a patented article can, of course, charge such price as he may choose, and the owner of a patent may assign it, or sell the *right* to manufacture and sell the article patented, upon the condition that the assignee shall charge a certain amount for such article."

The doctrine of this case, as respondents correctly state, was affirmed in *U. S.* v. *General Electric Co.*, 272 U. S. 476, but what this Court in both cases held valid was a restrictive covenant *between the immediate parties to the contract.* Neither case involved the rights of a purchaser, though this Court in its *General Electric* decision, in drawing the distinction between licensor and licensee relations on the one hand, and patentee (or licensee) and purchaser relations

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[1] *Supra*, page 12.

on the other, summarized what it had previously held with respect to the rights of a purchaser of a patented article, in the following language (272 U. S. 476, 489):

> "it is well settled, as already said, that where a patentee makes the patented article and sells it, he can exercise no future control over what the purchaser may wish to do with the article after his purchase. It has passed beyond the scope of the patentee's rights."

This statement by this Court is far removed from the assumed "general rule" asserted by the respondents, nor can they avoid the effect of what this Court has said on the subject by sweeping it aside,—as they attempt in their brief to do—as *obiter dicta* or mere expressions of general opinion.

Respondents can find no added support in their quotation from Robinson on Patents.[1] What the author said in the italicized portion, quoted by respondents, with respect to conditions that may be imposed by the patentee clearly refers to *contractual limitations or conditions*. That text was published in 1890, a few years prior to the decisions of this Court in *Hobbie* v. *Jennison*, 149 U. S. 355 and *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, although, of course, after the decision in *Adams* v. *Burke*, 17 Wall. 453 which had been decided in 1873. In the *Keeler* case this Court, on reviewing its earlier decisions on the subject, pointed out (157 U. S. 656, 666-667):

> "Upon the doctrine of these cases we think it follows that one who buys patented articles of manufacture *from one authorized to sell them* becomes possessed of an absolute property in such articles, unrestricted in time or place. *Whether a patentee may protect*

[1] Respondents' brief, p. 26.

himself and his assignees by special contracts brought home to the purchasers is not a question before us and upon which we express no opinion. It is, however, obvious that such a question would arise as a question of contract, and not as one under the inherent meaning and effect of the patent laws."

We believe this quotation is indeed dispositive of respondents' contention.

(1) Cases relied on by respondents as establishing a "general rule".

Respondents rely upon six cases as purporting to support the general rule as respondents understand it to be, but on analysis it clearly appears that they are neither relevant nor do they state the principles accepted and applied by this Court in the "license notice" cases. To illustrate:

(1) In *Holiday* v. *Mattheson*, 24 Fed. 185[1] where the facts were entirely unlike those in the case at bar, if the general language of the opinion as quoted by respondents "* * * where a license accompanies the transfer"—is to be taken to mean that restrictive conditions are good only in actual licenses as distinguished from sales, the statement need not be questioned. However, the Court predicated its views on *Hatch* v. *Adams*, 22 Fed. 434 which was expressly overruled in the *Keeler* case (*supra*). The facts disclose no sale with restrictive conditions attached.

(2) In *Dickerson* v. *Tinling*, 84 Fed. 192[2] all that the Court held in substance was that the sale of articles in the United States under a United States patent cannot be controlled by foreign laws, a ruling based upon the analogous case of *Boesch* v. *Graff*, 133 U. S. 697.

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[1] Respondents' brief, p. 27.
[2] Respondents' brief, p. 27.

(3) *General Electric Co. v. Continental Lamp Works*, 280 Fed. 846[1] was concerned simply with a conceded infringement by a manufacturer who had made a gas filled lamp in direct violation of the patents of the General Electric Company but who claimed that the palpable infringement was nullified by his purchase of unpatented bases for the lamps from the patentee.

(4) At this juncture respondents again come forward with *Mitchell v. Hawley*, 16 Wall. 544,[2] arguing that the case illustrates the application of the rule to restrictions on use. Again, we reply that if respondents intend to convey by their statement that the case illustrates a limitation on the use of a device imposed upon a purchaser from a licensee who had the power of sale, we repeat that respondents are gravely in error. The facts show no such situation as claimed by respondents.

(5) In *Porter Needle Co. v. National Needle Co.*, 17 Fed. 536,[3] the Court again was concerned merely with a question of license and not one of sale. A written license had been granted to *use* certain machines for a fixed period. The Court restrained the *licensee* from use of the machines after the termination date fixed by the license, a ruling proper under the authority of *Mitchel v. Hawley*. The case is therefore not in point. It is interesting to note, however, that the Court there pointed out that the defendant knew that the plaintiff *licensed* but did not *sell*.

(6) In *Skee Ball Co. v. Cohen*, 286 Fed. 275,[4] all that can be gathered from the opinion is that the Court had to

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[1] Respondents' brief, pp. 27-28.
[2] Respondents' brief, pp. 29-30.
[3] Respondents' brief, pp. 31, 52-53.
[4] Respondents' brief, pp. 31-32.

deal with an ordinary *license agreement* under the terms of which the licensee was to *use* the device or to license others to use it within a designated territory. If that were so, the decision could have been put squarely on the authority of *Mitchell* v. *Hawley*, or, perhaps, the Court looked upon the transaction as a transfer of a business with a covenant not to engage in the same enterprise within a specific territory. Such a negative covenant, unless "it tends to a . . nopoly" has been long enforced (*U. S.* v. *Addyston Pipe & Steel Co.*, 85 Fed. 271, 281-282), but has nothing to do with the claimed application of the patent law to restrictions imposed upon the use of patented articles after they have once been sold to the public. The irrelevancy, then, of this case to the one at bar must therefore be quite apparent.

(2) English authorities relied on by respondents.

Respondents' reliance on English cases upholding price fixing and other restrictions,[1] is of no avail in view of the directly contrary decisions of this Court.[2]

There is an obvious divergence between the English and our own Courts in the interpretation they give to the respective though similarly worded patent statutes of the two countries. This difference is alluded to in the opinions of the Justices of the High Court of Australia whose decision was overruled on appeal by the Privy Counsel in England (*National Phonograph Co.* v. *Menck*, 28 R. P. C. 229; the opinion below reported in 7 Comm. L. R. 481).

Apparently the English courts proceeded on the theory of separation of title from use in the case of a purchaser

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[1] Respondents' brief, pp. 22-29.

[2] *Bauer* v. *O'Donnell*, 229 U. S. 1, *Straus* v. *Victor*, 243 U. S. 490, *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8, *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U. S. 502 (Petitioner's brief, pp. 20-29). See also, dissenting opinion in the *Dick* case, 224 U. S. 1, 68.

of a patented device, a theory adopted in *Henry* v. *Dick*, 224 U. S. 1, by a four to three decision of this Court, but later expressly overruled in the *Motion Picture Patents* case. In that suit, the briefs reveal, that same contention was again made when the case reached this Court, but the argument was completely ignored and swept aside by this Court which affirmed the dismissal of the bill.

In concluding their discussion of these wholly irrelevant authorities, respondents quote at length from the opinion of this Court in *Independent Wireless Telegraph Co.* v. *Radio Corporation of America*, 269 U. S. 443, concededly a decision confined simply to a question of parties. Respondents, however, fail to introduce the quotation as this Court did, with the words; "The case made in the bill was this", —so as to make abundantly clear that what the Court said with reference to the facts of that case was but a paraphrase of the *pleading* and not even a suggestion, express or implied, of this Court's opinion on the subject.

As to respondents' contention that this Court has established "exceptions to the general rule".[1]

We look in vain for any statement by this Court in any of its opinions that it has ever established a rule that restrictions on a patented article will be enforced against the purchaser by an infringement suit under the patent law, or that this Court has ever created any exceptions to this rule. We are literally amazed at the suggestion.

On the contrary, this Court, particularly in the *Boston Store* case, reviewed its prior decisions on the subject and

[1] Respondents' brief, pp. 32-37.

concluded with a holding,—not that it had formulated any exceptions to its rules heretofore announced in those cases,—but that there was only one "fundamental ground upon which the decided cases must rest" (246 U. S. 8, 25). That fundamental ground, to quote the language of the Court, was that:

> "* * * a patentee could not use and exhaust the right to sell, as to which a monopoly was given him by the patent law, and yet by conditions and statements continue that law in effect so as to make it govern the things which by his voluntary act were beyond its scope * * *" (p. 23).

The fundamental ground common to the decided cases, some of which denied the possibility of projecting the monopoly right to sell, and others the possibility of projecting the monopoly right to use, over articles after sale, must be a denial of the right to apply the patent law to objects which by sale have passed beyond its scope. This *common* fundamental ground rising above mere questions of form, cannot be, as respondents contend, either the *particular* ground that price fixing is in itself unlawful, or the *particular* ground that the attempt to monopolize unpatented articles is in itself unlawful. The one thing common to them is that in both, what the patent owner sought to control lay outside of the monopoly. His sole recourse in such event, this Court said in the *Motion Picture Patents* case, is to the method of *special contract* but not to the patent law which permits no restrictions on patented articles after their sale. As this Court there held (243 U. S. 502, 509):

> "The extent to which the use of the patented machine may validly be restricted to specific supplies *or otherwise* by special contract between the owner of a pat-

> ent and the purchaser or licensee is a question ~~decided under~~ the *patent law* and with it we are not here concerned (*Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659.)"

This Court again had occasion to review the question in *U. S.* v. *General Electric*, 272 U. S. 476, and reiterated what it had said in *Straus* v. *Victor*, 243 U. S. 490, that:

> "These cases really are only instances of the application of the principle of *Adams* v. *Burke*, 17 Wall. 453, 456."

How can it be said that *Bauer* v. *O'Donnell*, *Bobbs-Merrill* v. *Straus*, *Straus* v. *Victor* and *Boston Store* v. *American*, to which this Court referred in the foregoing quotation and in which the attempt was to restrict the resale prices by printed notice or contract, are each and all "only instances of the application of *Adams* v. *Burke*" if, as respondents contend, the principle of *Adams* v. *Burke* was that an *unrestricted* sale, meaning a sale without notice of restriction, and only such a sale, takes the article outside of the monopoly? What principle is there common to all these cases excepting the principle that the sale of a patented article takes it outside the monopoly, and terminates all patent-law relations between the buyer and the seller, whether the sale be without any notice of restrictions (*Adams* v. *Burke*) or with a restricted "license notice" marked on the article sold (*Bobbs-Merrill* v. *Straus*, *Straus* v. *Victor*, *Bauer* v. *O'Donnell*, and the case at bar), or with a restrictive contract, the validity of which depends upon the general law and not upon the patent law (*Boston Store* v. *American*)?

Thus, there emerges firmly out of these Supreme Court cases not an "exception" as respondents contend, but the

very simple rule that the sale of a patented article takes it outside of the patent monopoly, and that rule rises above any mere form in which it is attempted to project the patent monopoly beyond the sale.[1]

The vice in respondents' distortion of the meaning of the phrase "subject to which the monopoly no longer applied" which they cull from the *Motion Picture Patents* decision,[2] therefore becomes apparent. For, how can respondents seriously assert that that phrase refers merely to supplies for the patented machine, when the opinion of the Court places its ruling in that quotation on *Bauer* v. *O'Donnell* and *Straus* v. *Victor* which have nothing to do with supplies but merely with the general principle of law enunciated by the Court that patented articles after their sale are not subject to the patent monopoly.

As to respondents' characterizations of the doctrines applied by this Court in the cases relied on by petitioner, as merely "broad language".[3]

Respondents presumably consider that when this Court refused to extend the scope of the patent monopoly to control patented articles after their purchase and sale, it was merely creating "exceptions" to a "general rule". But, as we have hereinabove observed, this Court has never spoken of any such exceptions or ever mentioned any such general rule as argued by respondents to exist in the opinions of this Court. We therefore find it difficult to explain respondents' reference to the "broad language" of this

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[1] See petitioner's brief, pp. 22-29, for complete discussion of the cases.

[2] Respondents' brief, pp. 46-47.

[3] Respondents' brief, pp. 39-48.

Court, unless it be that this alleged "broad language" constitutes a statement of the rule which this Court has applied to cases of the general character of the one at bar and which respondents now find unsuited to their purposes.

The Court of Appeals below suggested that what respondents now call "broad language" was in truth merely "obiter" and "not necessarily controlling". It assigned as a reason that inasmuch as the decisions in *Bauer* v. *O'Donnell*, *Straus* v. *Victor*, *Boston Store* v. *American* and *Motion Picture Patents* v. *Universal* involved attempted restrictions which were bad on grounds of public policy, the holding of this Court in those cases that those restrictions were equally bad under the patent law,—the sole question presented for decision—must have been surplusage. Such reasoning, we have heretofore observed, is erroneous.[1]

As Chief Justice TAFT said in *Richmond Co.* v. *U. S.*, 275 U. S. 331, 340:

> "* * * It does not make a reason given for a conclusion in a case obiter dictum that it is only one of two reasons for the same conclusion."

In *Myers* v. *U. S.*, 272 U. S. 106, 118, this Court held:

> "We are asked by the United States to treat the definite holding in *Marbury* v. *Madison* * * * as mere dictum—to disregard it. But a solemn adjudication by this Court may not be so lightly treated. * * * "

And in *U. S.* v. *Title Insurance and Trust Co.*, 265 U. S. 472, 485, it was held:

> "Enough has been said to make it apparent that that case and this are so much alike that what was said

[1] Petitioner's brief, pp. 31-34.

and ruled in that should be equally applicable in this. But it is urged that what we have described as ruled there was *obiter dictum*, and should be disregarded, because the court there gave a second ground for this decision which was broad enough to sustain it independently of the first ground. The premise of the contention is right but the conclusion is wrong; for where there are two grounds, upon either of which an appellate court may rest its decision, and it adopts both, 'the rule on neither is *obiter*, but each is the judgment of the court, and of equal validity with the other' (citing cases)."

As to respondents' erroneous observation with respect to the extra-judicial comment quoted by petitioner.[1]

Respondents, in attempting to minimize the full effect of Professor Williston's comments with respect to the decisions of this Court voiding license notice restrictions on patented articles after their sale,[2] add quotations from other portions of his book relating solely to restrictive covenants affecting land or contracts relating to the sale of a business. Those cases quite obviously have nothing to do either with the type of action or the issues here involved.

Nor can respondents distort the plain meaning of what Professor Williston has said by injudicious use of quotation marks so as to create the utterly false impression that his understanding of the law on the subject is precisely opposite to what the language of his remarks indicates. Those comments by him were, in this instance, not his views, but simply his interpretation of what this Court has held in the *Straus* v. *Victor, Motion Picture Patents, Boston Store*

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[1] Respondents' brief, pp. 49-53.
[2] Petitioner's brief, p. 30.

and *Carbice* cases. One of the authorities he cites as illustrative of what other Courts have recently stated with respect to their understanding of these decisions is so illuminating and exact a summary that it bears quotation at length. In *Chicago Daily News* v. *Kohler*, 196 N. E. 445, 449-450:

> "While a patentee may limit a license to making and using the patented article, he may sell it, and if he does, the sale places the article beyond his control as patentee. Thus, where a patentee manufactures the patented device and sells it he can exercise no future control over the article in the hands of the purchaser. Boston Store of Chicago *v.* American Graphophone Co., 246 U. S. 8, 38 S. Ct. 257, 261, 62 L. Ed. 551, Ann. Cas. 1918 C, 447; Keeler *v.* Standard Folding-Bed Co., 157 U. S. 659, 15 S. Ct. 738, 741, 39 L. Ed. 848; Adams *v.* Burke, 17 Wall. 453, 21 L. Ed. 700. The United States Supreme Court, in Keeler *v.* Standard Folding Bed Co., *supra*, said: 'One who buys patented articles of manufacture from one authorized to sell them becomes possessed of an absolute property in such articles, unrestricted in time or place.' *Federal decisions denying the right of patent owners, in selling patented articles, to reserve control over the resale or use,* do not rest upon any mere question of the form of notice attached to the articles, or the right to control, solely by reference to such notice, but upon *the basic ground that the control of the patent owner over the articles in question ends with the passing of title.* Boston Store of Chicago *v.* American Graphophone Co., *supra.* 'By virtue of the patent law' the Court said in the case last cited: 'One who had sold a patented machine and received the price and had thus placed the machine so sold beyond the confines of the patent law, could not by qualifying restrictions as to use keep under the patent monopoly a subject to which the monopoly no longer applied.''

With respect to petitioner's reference to Professor Chafee.[1]

Respondents, in complaining that our quotation from Professor Chafee's remarks is not extensive enough, omit to say that it represents Professor Chafee's summary of his understanding of the law as laid down by these cases.

It is interesting to note that the author, in commenting upon the "license notice" cases decided by this Court, makes the significant statement (p. 1002) that "In this country the vital distinction is drawn when title to the article passes". As put by this Court in *U. S.* v. *United Shoe Machinery Co.*, 247 U. S. 32, 58, a patentee "cannot grant the title and retain the incidents of it".

Throughout their brief respondents disregard this essential distinction. In their quotations from the opinions of this Court in which reference is made to "unconditional sales" they repeatedly overlook the fact that what was meant was a transaction in which title did not pass.[2] Conditional sales are well known to the law as meaning only those in which title does not pass until the occurrence of a certain event. This Court treats the "license notice" cases before it on the principle that conditions cannot attach to an *absolute* sale but recognized that if the patentee or his licensee so desire they may contract *specially* with respect to any conditions desired to be imposed on purchasers. Such contractual limitations are, however, as this Court has repeatedly held, entirely outside of the scope of the patent law.[3]

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[1] Respondents' brief, p. 30.
[2] Respondents' brief, p. 46, note 1.
[3] *Hobbie* v. *Jennison*, 149 U. S. 355, 363; *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, 661.

Conclusion.

The decision of the Court of Appeals below was in error and should be reversed, and the cause remanded to the District Court for the Southern District of New York, with instructions to dismiss the Bill of Complaint.

Respectfully submitted,

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IN THE

Supreme Court of the United States.

OCTOBER TERM, 1937.

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC. AND AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

BRIEF FOR RESPONDENTS IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI.

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IN THE

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WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC. and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

BRIEF FOR RESPONDENTS IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI.

Statement.

These are three separate suits for patent infringement, based upon different patents for inventions in vacuum tube amplifiers which have been used in wire telephony, radio telephony, talking motion pictures and other fields. There are seven of these patents in all. The several suits were tried together below and will be treated as a single case here.

The District Court (Southern District of New York)[1] and the Circuit Court of Appeals for the Second Circuit in a unanimous opinion,[2] concurred in holding that six of these patents were valid and had been infringed by petitioner in its use of the amplifiers complained of. The seventh patent was held invalid by both Courts. The petition involves only the patents that were held valid below.[3]

There is no conflict of decisions between Circuit Courts of Appeals with regard to any of these patents. Nor is there any unsettled question of general or public importance involved in this case.

Reasons Advanced by Petitioner for Granting Certiorari.

Three questions of law are urged by petitioner as reasons for granting certiorari. A fourth reason advanced is merely that the questions of law are of public importance.

The first two of these questions are not involved in this case at all. The third was decided by both Courts below in accordance with precedent.

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[1] (III, 1683-1692).

[2] (III, 1712).

[3] The inventions of all of the patents were made while the art of amplification was still in its infancy. The latest of the inventions was made in 1916. Two of the patents have already expired (II, 616, 628), two will expire in 1939 (II, 621, 637) and two in 1940 (II, 641, 644). Also, two of the patents were sustained in earlier suits (No. 1,231,764, II, 616, in *Western Electric Co. et al.* v. *Wallerstein*, 60 F. (2d) 723; No. 1,426,754, II, 621, in *Radio Corp. et al.* v. *Bunnell, et al.*, 22 F. (2d) 847).

POINTS I and II.

The first two questions of law stated in the petition are not involved in this case.

These questions, as stated in the petition, are: (1) whether the owner of a patent can, by means of the patent, restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade and full consideration paid therefor, and (2) whether a patent owner can, merely by a "License Notice" attached to a device made under the patent, and sold in the ordinary channels of trade, place an enforceable restriction upon the purchaser thereof as to the use to which the purchaser may put the device.

These questions are not involved in this case because the amplifiers in question were manufactured and were sold to petitioner by a company which, *as both knew at the time, had no license to make those sales.* Those sales were therefore an *infringement* of the patents and conveyed to petitioner no rights whatever under the patents.

The facts are these. The manufacturer which made these infringing sales to petitioner was American Transformer Company. It had a license under the patents in suit, but that license was expressly limited in Paragraph 1 (III, 1415) to the right—

> "to manufacture * * *, and to sell *only* for radio amateur reception, radio experimental reception, and radio broadcast reception * * *".

Or, stating it generally, the Transformer Company's selling rights under that license were *confined* to selling the patented amplifiers for *private* or *home* uses, as distinguished from *business* or *commercial* uses, such, for example, as used in equipment for talking picture theatres. It had no license to sell the amplifiers for these business or commercial uses.

An *exclusive* license in this commercial field was held by respondents, Western Electric Company and Electrical Research Products, Inc., both of which are subsidiaries of respondent, American Telephone and Telegraph Company, the owner of the patents in suit (II, 1208). One of the businesses in which they were actively engaged under that exclusive license was that of supplying talking picture equipment to theatres.

Petitioner was a competitor in that business. It was *for use in that business* that it purchased the patented amplifiers here in controversy from the American Transformer Company, *in spite of the fact that that company had no license to sell amplifiers for such a use.* And in that transaction both parties were acting with the full knowledge of the facts; *both knew of the use for which the amplifiers were sold, and both knew that the Transformer Company was not licensed to make such sales.*[1]

Accordingly, those sales and petitioner's subsequent leasing of those amplifiers to theatres, were *deliberate infringements*—just as much so as if the Transformer Company had had no license at all. As was held by the Court of Appeals (III, 1724)—

> "It was beyond the scope of the American Transformer Company's license to sell the amplifiers for the use for which it sold them to defendants. The sale was therefore an infringement and not a licensee's lawful sale."[2]

Thus it clearly appears that the first two questions of law referred to in the petition are not involved in this case in any way. We are not concerned with any question

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[1] Petitioner's admission (I, 325); the findings of both Courts below (III, 1723, 1627-8).

[2] *St. Louis* v. *Sanitary Co.*, 178 Fed. 923, 927 (C. C. A. 8); *General Electric Co.* v. *Continental Lamp Works*, 280 Fed. 846, 851 (C. C. A. 2); *Radio Corp.* v. *Cable Corp.*, 66 F. (2d) 778, 782 (C. C. A. 2); *Robinson on Patents*, Secs. 915, 916; *Walker on Patents*, Sec. 347.

regarding the enforcement of restrictions upon patented articles after a licensed sale, or after a sale by the patent owner himself. For here the sale by which petitioner acquired the amplifiers in question was *beyond the scope of the seller's license* and therefore was an *unlicensed sale—an infringement*. Accordingly, petitioner is in exactly the same position and just as much an infringer as if petitioner had made the amplifiers itself or had purchased them from another who had no license at all.

Petitioner repeatedly states that full consideration was paid by it for the infringing amplifiers. The only consideration paid by petitioner was paid to American Transformer Company, which, as we have seen, was also an infringer and had no right to sell the amplifiers or to receive any consideration therefor.

The District Court and the Circuit Court of Appeals were clearly right in dismissing the license defense and in holding petitioner to be an infringer.

Although academic so far as this case is concerned, it is nevertheless true that restrictions on the use of patented articles, imposed by the patentee, or by a licensee having an unrestricted right to sell the patented article, and brought to the knowledge of the vendee at the time of sale, have been uniformly upheld by this and the lower Federal Courts[1] except only in cases where the restrictions themselves were clearly improper and against public policy, as, for example, restrictions on the *resale price* at which the patented article may be sold[2] and restrictions

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[1] See the opinions below III, 1629-1637, 1723, 1724; also *Mitchell* v. *Hawley*, 16 Wall. 544; *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536, 537 (C. C. Mass., Lowell, J.); *Dickerson* v. *Tinling*, 84 Fed. 192 (C. C. A. 8); *Dickerson* v. *Matheson*, 57 Fed. 524 (C. C. A. 2); *General Electric Co.* v. *Continental Lamp Works*, 280 Fed. 846, 851 (C. C. A. 2); *Skee Ball Co.* v. *Cohen*, 286 Fed. 275, 276, 277 (E. D. N. Y.); *Radio Corp.* v. *Andrea*, 90 F. (2d) 612, 614, 615 (C. C. A. 2).

[2] *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor Talking Mch. Co.*, 243 U. S. 490; *Boston Store* v. *Am. Graphophone Co.*, 246 U. S. 8.

that the patented article cannot be used except with *unpatented* supplies purchased from the patentee.[1] Such restrictions have been held to be—as they clearly are—outside the monopoly and therefore unenforceable. Sharply distinguished from such restrictions are those restricting the patented device to a specified field of use. The latter are definitely within the patent monopoly and therefore enforceable. But since this point is not involved here, we shall not discuss it further.

POINT III.

As Point III, petitioner contends that a patent which issued upon a continuing or divisional application, is invalid if the patentee or his assignee had put the invention into public use more than two years before such application was filed, even though the invention was fully disclosed in an original and copending application filed either before or within two years after the public use, and even though broader combinations of the elements of the invention were claimed in the original application.

Petitioner cites the following cases: *Westinghouse Electric* v. *Jeffrey-DeWitt Insulator Co.*, 22 F. (2d) 277 (C. C. A. 2); *Crown Cork & Seal Co.* v. *Ferdinand Gutmann Co.*, 86 F. (2d) 698 (C. C. A. 2); *Webster Electric* v. *Splitdorf*, 264 U. S. 463; and *Chapman* v. *Winthroath*, 252 U. S. 126. No such proposition was decided in any of these cases, as appears from the opinions of both Courts below (III, 1680-1683; 1721-1722) and from the cases themselves.

The public use relied upon is that of respondent, American Telephone & Telegraph Company—the *patentee or patent owner*—in the Transcontinental Telephone Line which was first opened to the public in January, 1915.

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[1] *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502, overruling *Henry* v. *Dick Co.*, 224 U. S. 1.

Petitioner refers to this public use as being a public use of the inventions of all five of the Arnold patents originally in the case (Petition, pp. 4 and 5). The inventions of only three of these patents were so used, namely, patents Nos. 1,329,283, 1,448,550 and 1,520,994, as was found by both of the Courts below (III, 1679, 1721). The last of these patents is not involved in the petition since it was held invalid by the Court below on other grounds and respondents have made no application to this Court regarding it.

Point III of the petition, therefore, need be considered only in connection with patents Nos. 1,329,283 and 1,448,550.

Both of these patents issued on continuing applications (see the patents, II, 628, 641). Patent No. 1,329,283 issued on an application filed July 30, 1918, which was a continuation of two earlier applications Serial Nos. 841,567 and 841,568, filed May 28, 1914 (II, 628); and patent No. 1,448,550 issued on an application filed February 3, 1919, which was a continuation of two earlier applications Serial Nos. 59,210, filed November 2, 1915, and 48,873, filed September 3, 1915 (II, 641). It is admitted in the petition (page 4) that the inventions of the particular combinations of elements of the claims in suit of these patents were fully disclosed in the original applications, filed in 1914 and 1915, respectively. Also, there was continuity of prosecution between the original applications and the later filed continuing applications, the continuing applications having been filed while the original applications were still pending in the Patent Office (see patents, II, 628, 641). In the case of patent No. 1,329,283, the original application was filed more than a year *before* the public use relied upon, and the original application for patent No. 1,448,550 was filed less than a year *after* the public use.

In accordance with precedent,[1] both Courts below overruled petitioner's contention that these Arnold patents were invalid because of this public use, and soundly distinguished the cases upon which petitioner relies (cited *supra*, page 6). Each of these cases involved intervening adverse rights of the defendant or some third party. In the present case there are no such intervening rights. Petitioner did not use any of the inventions until the year 1929.

The most important object of the patent law is to encourage the use of new inventions. If the contention made by petitioner were the law, no patentee could safely make his invention available to the public, even after he had filed a patent application fully disclosing the invention, until such time thereafter that he could be certain it would not be necessary or desirable for him to file any continuing or divisional applications to protect his invention. As stated by the Court of Appeals for the Sixth Circuit in an opinion by Judge Denison in the case of *Wirebounds Patent Co.* v. *Saranac*, 37 F. (2d) 830, 841,

> "This case is plainly not within the Splitdorf rule,[2] as we understand it, either by parallelism or by strict analogy. Defendant points out, as a general analogy, that the machine and method had been in public use by the applicants, who became the patentees, and under licenses from them, all for more than two years before the divisional application was filed. This is true. When it is remembered that the divisional application is normally entitled to the benefit of the

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[1] *Wirebounds Patent Co.* v. *Saranac*, 37 F. (2d) 830, 841 (C. C. A. 6); *American Chain Co.* v. *Franklin-New York Co.*, 34 F. (2d) 551 (E. D. N. Y.); *American Chain Co.* v. *Stewart-Warner Speed. Corp. et al.* (S. D. N. Y., decided September 26, 1928, Thacher, *J.*); *American Laundry Mchy. Co.* v. *Prosperity Co.*, 295 Fed. 819 (C. C. A. 2).

[2] *Webster Electric* v. *Splitdorf*, 264 U. S. 463, cited by petitioner (*supra*, p. 6).

original filing date, it is not easy to see how public use under license from the applicants can amount to that laches under which adverse rights may arise; or how the Splitdorf rule can apply unless the delay is after the public appearance of an adverse claimant, or, perhaps, one who may be an adverse claimant."

On page 22 of its brief, petitioner states in effect that counsel for respondents at no time contended that broader claims than those in suit were ever made in the original applications on which these Arnold patents are based. It was clearly and definitely pointed out in respondents' brief in the Court below that, although the particular combinations of elements of the claims in suit were not specifically claimed in the original applications, broader combinations were claimed. And the Court of Appeals so found (III, 1722).

POINT IV.

The fourth reason advanced for granting certiorari is merely that the questions of law stated in the petition are of public importance. We have shown that two of those questions are not involved in this case and that the third has been correctly decided in accordance with precedent. Further comment on Point IV of the petition is, therefore, deemed unnecessary.

Conclusion.

The petition for writ of certiorari fails to show any reason which should move this Court to review the carefully considered concurrent decisions of the Courts below. The case presents no unsettled question of general or public importance and no question as to which there exists a conflict of decisions of the lower Federal courts. Nor is the decision below in conflict with any decision of this Court.

The petition for writ of certiorari should be denied.

Respectfully submitted,

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CHARLES ELMORE CROPLEY
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IN THE

Supreme Court of the United States

OCTOBER TERM, 1937

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC. and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

MEMORANDUM ON BEHALF OF RESPONDENTS.

We have shown in our brief in opposition to the petition that the Transformer Company, from which petitioner purchased the amplifiers in question, had no right to make that sale. It was *beyond the scope of the seller's license* and therefore was an *unlicensed sale*—an infringement—which could convey no rights upon petitioner under respondents' patents.

On page 1 of its reply brief, petitioner makes the wholly unfounded statement that "Exactly this situation existed, and the same contention was made, in each of the cases cited by petitioner in support of its petition." and refers to *Adams* v. *Burke*, 17 Wall 453; *Hobbie* v. *Jennison*, 149 U. S. 355; *Straus* v. *Victor*, 243 U. S. 490; and *Motion Pictures Patent* Case, 243 U. S. 502. In none of these cases did this situation exist; in none of them was this contention made.

In *Adams* v. *Burke, supra,* and also *Hobbie* v. *Jennison, supra,* the sale was made by an assignee of the entire right in the patent for a particular territory, who had the unquestioned right to make the sale in the territory where it was in fact made. And this Court so found, stating in both cases that the articles in question were "lawfully made and sold."[1] In neither case was the sale an infringing one.

So also in *Straus* v. *Victor, supra,* the phonographs in question were made and sold by the patent owner itself, the Victor Company, to a dealer from whom they were purchased by the defendant, Straus. The phonographs were therefore lawfully made and sold.[2]

And finally, in the *Motion Picture Patents Case, supra,* the motion picture machine was made and sold to the Seventy-second Street Amusement Company by the Precision Machine Co. within the scope of its license. It was a licensed sale, and not an infringing sale as in the case at bar. The point of the decision was that the restriction imposed in conjunction with such a *licensed* sale, confining the use of the machine to use with unpatented supplies to be purchased from the patentee, was improper and invalid. It has no pertinency here where the sale to petitioner was not licensed or authorized by the patent owner and where we are not concerned in any way with any restriction regarding the supplies with which a patented machine may be used.

Respectfully submitted,

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[1] *Adams* v. *Burke,* 17 Wall. 453, *457; Hobbie* v. *Jennison,* 149 U. S. 355, *363.*

[2] *Straus* v. *Victor,* 243 U. S. 490, *496.*

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BRIEF FOR RESPONDENTS.

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IN THE

Supreme Court of the United States

OCTOBER TERM, 1937

No. 357

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC. and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

BRIEF FOR RESPONDENTS.

Opinions of the Courts Below.

The opinion of the Circuit Court of Appeals for the Second Circuit is reported in 91 F. (2d) 922. It will be found in this record at Volume III, page 1712.

The opinion of the District Court is reported in 16 F. Supp. 293. In this record it is at Volume III, page 1618.

Jurisdiction.

This case is here on a writ of certiorari to the Circuit Court of Appeals for the Second Circuit under the provisions of United States Code, Title 28, Section 347.

Statement of the Case.

The inventions of the patents involved in this infringement litigation relate to vacuum tube amplifiers.

All of these patents that are now before this Court were held valid and infringed in this case in concurring decisions by the District Court for the Southern District of New York and by the Circuit Court of Appeals for the Second Circuit.

These patents are:

1. *Lowenstein, No. 1,231,764,* issued July 3, 1917 (II, 616)—*The Negative Grid Bias Patent*—filed April 24, 1912; claims 1, 2, 4, 5, 6, 7; these same claims were sustained also in *Western Electric Co., et al.* v. *Wallerstein,* 60 F. (2d) 723 (C. C. A. 2) and claims 1 and 7 were sustained previously in *Radio Corp. et al.* v. *Bunnell, et al.,* 22 F. (2d) 847 (S. D. N. Y.), from which no appeal was taken.

2. *Mathes, No. 1,426,754,* issued August 22, 1922 (II, 621)—*The Grid Biasing Resistance Patent*—filed October 23, 1916; claim 8; sustained in *Radio Corporation* v. *Bunnell, et al., supra.*

3. *Arnold, No. 1,329,283,* issued January 27, 1920 (II, 628)—*The Power Circuit Patent*—original applications filed May 28, 1914; claims 7, 10, 13.

4. *Arnold, No. 1,403,475,* issued January 17, 1922 (II, 637)—*The Resistance-Capacity Coupling Patent*—original application filed September 3, 1915; claims 8, 9, 10.

5. *Arnold, No. 1,448,550,* issued March 13, 1923 (II, 641—*The Definite Input Impedance Patent*—original applications filed September 3, 1915 and November 2, 1915; claims 1, 12.

6. *Arnold, No. 1,465,332,* issued August 21, 1923 (II, 644) —*The Common Plate Supply Patent*—original application filed September 3, 1915; claims 1, 3, 5, 8, 10, 11.

Two additional patents, which were held invalid below, are not before this Court.

The inventions covered by all of these patents were made between 1912 and 1916 when the amplifier art was in its infancy, and long before amplification had been applied commercially to the now commonplace fields of radio broadcast transmission and reception, public address systems and talking motion pictures. All of these inventions are products of research in telephony. And, with the single exception of the Lowenstein invention, all were made by research scientists in the employ of respondent, Western Electric Company, the manufacturing subsidiary of respondent, American Telephone and Telegraph Company.

It was in 1912 that DeForest took his three-element vacuum tube detector to the Telephone Company.[1] During the six years that had elapsed since his invention of this device, DeForest had made little or no progress with it as an amplifier.[2] Neither he nor anyone else knew how the mysterious thing worked.[3]

The present day usefulness of that tube as an amplifier is attributable in large part to inventions of patents here in suit, which were made by engineers of the Telephone Company in the course of the intensive development work which they began in 1912. It was as a result of certain of those inventions in vacuum tube amplifiers that the Telephone Company was enabled to inaugurate transcontinental telephone service early in 1915, and to talk by radio telephone between Arlington, Va., and Honolulu, Paris and other distant places later in that year.[4]

In his Franklin Institute paper of 1920,[5] DeForest characterized this work of the Telephone engineers as "be-

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[1] III, 1655.

[2] II, 724, and *Western Electric Co.* v. *Wallerstein*, 60 F. (2d) 723, 724.

[3] See the statement in DeForest's patent No. 879,532, III, 1429, lines 77 to 82.

[4] I, 105; and see the contemporaneous comments of the public press on these great achievements, II, 659.

[5] II, 716, 717.

yond all praise" and "unique in the annals of brilliant achievement in electrical engineering".[1]

The leader in this work was Dr. Arnold, who, at the time of his death in 1933, was the director of research of the Bell Telephone Laboratories.[2] The four patents here in suit which bear his name represent important contributions which he himself made at the inception of this new art.

The broad and difficult problem with which these early workers in this art were confronted was to amplify, *without distortion,* and *with large increase in energy,* substantially the entire range of frequencies composing the audible spectrum,[3] and particularly the highly complicated combinations of widely different frequencies which constitute the usual sounds of speech and music. Distortion was due to many causes and occurred at various points in the amplifier. Every circuit and circuit element, from the point at which the sound currents to be reproduced are picked up to the point at which they are finally reproduced in amplified form, was a potential source of distortion and each such source presented its own individual problem which had to be solved before a faithful reproduction could be obtained. And in order to secure the large increase in energy that was required, it was necessary to ascertain the principles of operation of the mysterious three-element vacuum tube, and to discover how it should be constructed and with what circuits it should be used, so as to give that enormous amplification.

The inventions of the patents in suit represent solutions of these various problems. These inventions have been

[1] See also the same paper, II, 719.

[2] I, 587. The Bell Telephone Laboratories was formed in 1925 and has since conducted the research and development work formerly carried on by the Western Electric Co.

[3] The range of audible frequencies is from 16 to 16,000 vibrations per second, as compared with the piano range of from 30 to 5,130 vibrations per second.

used extensively over a long period of years in numerous fields, including wire telephony, radio telephony, public address systems, electrical recording and reproducing of phonograph records, talking motion pictures and many others.[1]

Petitioner admits the usefulness and commercial success of these inventions,[2] and admits also that all of them are embodied in its amplifiers which are here charged to infringe.[3]

Representing as they do, inventions made at the very beginning of the amplifier art, the patents in suit have reached, or are about to reach, the end of their terms. Two of them have expired during this litigation. All of the remainder will expire by 1940.[4]

The Parties:

The respondents, plaintiffs below, are American Telephone and Telegraph Company and its subsidiaries, Western Electric Company, Incorporated, and Electrical Research Products, Inc. The Telephone Company owns the patents in suit. The two subsidiary companies are exclusive licensees under those patents in the commercial field of sound recording and reproducing.[5] During the

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[1] I, 91. See also the testimony of Wilcox as to the extensive use of the inventions in the Western Electric talking motion picture sound recording and theatre reproducing systems, I, 494-500.

[2] I, 502, 94, 498. The court below found that "There can be no earnest denial of the usefulness and commercial success of the inventions which were held valid below (III, 1713).

[3] Petitioner's denial of infringement is based upon other grounds (*infra*, p. 8).

[4] Nos. 1,426,754 and 1,403,475 expire in 1939; and Nos. 1,448,550 and 1,465,332 expire in 1940.

[5] I, 603, 604; II, 1208; *Western Electric Co. et al.* vs. *Pacent*, 37 F. (2d) 14 (C. C. A. 2). Their exclusive license was subject to a non-exclusive license which had previously been granted to Radio Corporation in that field (III, 1400).

time of the infringement here complained of, those two companies were actively engaged under their exclusive license in making, and supplying to theatres, talking picture equipment which included amplifiers embodying the inventions of the patents in suit.

The petitioner was also a supplier of talking picture equipment to theatres.[1] The infringement with which petitioner is charged consists in supplying to theatres as part of their talking picture equipment, amplifiers which admittedly embody the inventions of the patents in suit.

Outline of Argument:

Each of the defenses here urged by petitioner was overruled by concurring decisions of the courts below. We shall devote a separate part of this brief to each of these alleged defenses.

Part I is devoted to the alleged defense to which petitioner's Points I and II are directed, namely, that petitioner did not infringe the patents in suit because its purchase of the amplifiers in question gave it an implied license to do with them as it chose.

Part II is devoted to petitioner's contention (Point III) that respondents are barred from maintaining this suit under principles of ratification and estoppel.

Part III is devoted to the alleged defense of invalidity against certain of the Arnold patents in suit (petitioner's Point IV) based upon the use of the inventions of those patents by the patent owner, which use occurred more than two years before the filing of the continuation applications upon which those patents issued, but *not* two years before the filing of the original applications disclosing those inventions. Petitioner contends that this defense is applicable to all four of the Arnold patents. But as we shall see, it cannot possibly apply to more than two of them, because the public use involved the inventions of only two.

Part IV is devoted to petitioner's assertion (Point V) that all of the patents in suit are invalid for anticipation or lack of invention over the prior patented art.

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[1] I, 367.

The alleged defenses to which Parts II and IV of this brief are directed (petitioner's Points III and V) were included in the specification of errors which the brief accompanying the petition stated would be urged if the writ of certiorari were allowed.[1] But no reference was made to them in the petition itself, either under the heading "Questions Presented",[2] or under the heading "Reasons relied upon for the Grant of a Writ of Certiorari",[3] or elsewhere. And no mention was made of them in the Argument of the brief accompanying the petition. Therefore it would appear that these defenses were definitely *not* grounds "upon which the writ of certiorari was asked or granted."[4]

Furthermore, the questions raised in these two defenses are essentially questions of fact, and have been decided against petitioner by both of the courts below.[5]

For both of these reasons, we doubt that this Court will desire to consider these defenses on the present petition.[6] However, since petitioner's brief deals with them we feel compelled to do likewise.

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[1] Petition, pages 10, 11.

[2] *Id*, page 5.

[3] *Id*, page 5.

[4] In *Alice State Bank, et al.* v. *Houston Pasture Company*, 247 U. S. 240, 242 it was said:

> "• • • But as that is not the ground upon which the writ of certiorari was asked or granted we confine our discussion to the matter relied upon in asking the intervention of this Court. *Hubbard* v. *Tod*, 171 U. S. 474, 494."

See also *Algernon S. Schafer* v. *Helvering*, 299 U. S. 171, 172.

[5] *Thomson Spot Welder Co.* v. *Ford Motor Co.*, 265 U. S. 445, 447; *Concrete Appliances Co.* v. *Gomery*, 269 U. S. 177, 180; *Texas & N. O. R. Co.* v. *Brotherhood Ry. &c.*, 281 U. S. 548.

[6] There is no conflict of decisions as to the validity of any of the patents.

PART I.

Petitioner had no license, implied or otherwise, under the patents in suit.

Petitioner contends that although the amplifiers in controversy embody the inventions of the patents in suit, petitioner's use of them did not infringe those patents because they were purchased by petitioner from American Transformer Company, a licensee under the patents, and therefore, according to petitioner, they carried with them an implied license permitting petitioner to do with them as it chose. A complete answer to this contention is, we believe, that the American Transformer Company's license was a *limited* license, and its sale of the amplifiers to petitioner was *outside of the scope of that license* and therefore an *infringement*, as was known at the time by both parties to the transaction. Accordingly, no rights under the patents were conferred upon petitioner by the sale.

The facts are these. Amplifiers embodying the inventions of the patents here involved are useful in various fields, including the *commercial* field of sound recording and reproducing, which embraces talking picture equipment for theatres, and the *private or home* field which embraces radio broadcast reception, radio amateur reception and radio experimental reception. We designate this latter field by the convenient expression "private or home", because practically all of the radio reception included in that field is of that character. As we have said, respondents, Western Electric Company and Electrical Research Products, Inc., were, at the time in controversy, exclusive licensees under the patents in suit, for the commercial field of sound recording and reproducing[1] and, under that license, were actively engaged in the business of supplying the patented amplifiers to talking picture theatres, etc. American Transformer Company was one of a number of manufacturers who held non-exclusive licenses confined to the manufacture and sale of the pat-

[1] I, 603, 604.

ented amplifiers for *private or home* use, as distinguished from *business or commercial* use.[1] These licenses were granted by Radio Corporation acting for itself and also for respondent, American Telephone and Telegraph Company, and were assented to by the latter.[2]

The American Transformer Company's license was confined by the express terms of the grant, to the right[3]—

> "to manufacture * * *, and to sell [the patented amplifiers] *only* for *radio amateur reception, radio experimental reception, and radio broadcast reception* * * *."[4]

In other words, the Transformer Company had *no right or license to sell the patented amplifiers for use in theatres as part of talking picture equipment, or for any other use not specified in its license.*

Nevertheless, the Transformer Company sold the amplifiers in controversy to petitioner *for that particular commercial use. It did so knowing that they were going to be put to that use.*[5] This is established by the testimony of the Transformer Company's president[6] and its sales agent.[7] Indeed, petitioner *admits* that the Transformer Company "*knew that the amplifiers it sold to petitioner were to be used in the motion picture industry.*"[8] Such sales were extensive and recurrent, continuing even after this suit was brought.[9] Furthermore, petitioner, in

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[1] Arrangements of this kind are not at all unusual. It is *stipulated* in this case (I, 585, 586):

> "it is *common practice* where a patented invention is applicable to different uses, to grant written licenses to manufacturers under United States Letters Patents restricted to one or more of the several fields of use permitting the exclusive or non-exclusive use of the invention by the licensee in one field and excluding its use in another field."

[2] III, 1423.

[3] III, 1415.

[4] Emphasis ours throughout this brief unless otherwise noted.

[5] I, 341, 383, 408.

[6] I, 407, 408.

[7] I, 341.

[8] Brief, page 36.

[9] III, 1580 *et seq.*

purchasing those amplifiers from the Transformer Company for that use, *had actual knowledge that the Transformer Company had no license to make such a sale, as the record clearly shows,*[1] *and as the District Court specifically found.*[2]

Although the Transformer Company knew that these amplifiers were to be used for the commercial use noted, and although it sold them *outside* of the license, for that particular use, it went through the form of affixing to them the same notice[3] that it customarily affixed to amplifiers sold by it *under* the license, as required by its paragraph 5, *viz.* (III, 1418):

> "License Notice—This Apparatus is Licensed Only for Radio Amateur, Experimental and Broadcast Reception Under the Following Patents of the Radio Corp'n of America and Associated Companies,"

listing the patents. The notice so affixed was a mere pretense and was intended by both the Transformer Company and petitioner to be "disregarded".[4]

The Circuit Court of Appeals found[5]—

> "It was beyond the scope of the American Transformer Company's license to sell the amplifiers for the use

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[1] I, 358, 359. In its letter of November 23, 1928 to petitioner, in reply to the latter's initial request for information and prices (II, 731), the Transformer Company said (II, 732):

> "We have your letter of the 17th in regard to amplifiers to be used *with phonograph and the like in theatres.*
>
> "The license which we have with the Radio Corporation of America is that *the amplifier is to be used for broadcasting reception and for experimental and amateurs use only and not for commercial use.* That is the type of license notice which is placed upon the amplifier and *is the only way which we can sell them.*"

[2] III, 1627 and 1645. At page 1628, the court quotes the above letter in support of its finding.

[3] I, 360, Plaintiffs' Exhibit 30; II, 734.

[4] I, 370.

[5] III, 1724.

for which it sold them to defendants [petitioner]. The sale was therefore an infringement and not a licensee's lawful sale."

After acquiring the amplifiers through this unlicensed, infringing sale, petitioner proceeded to lease them for a large consideration to theatres for use in reproducing talking pictures.[1] It is that act that is here charged as an infringement.

Argument.

In its main argument of non-infringement, petitioner ignores the fact that the sale of the amplifiers by the Transformer Company to petitioner was *outside* of the Transformer Company's license to sell, and treats the situation as if that sale had been *under* the patents in suit (i. e., by the patent owner itself or *under* a license from the patent owner). Upon the erroneous assumption that the sale was *under* those patents, petitioner contends that by that transaction it acquired the unrestricted right to use the amplifiers as it wished, in spite of its admission that it had actual knowledge at the time of sale that they were licensed for private or home use only and not for commercial use. For, says petitioner, a patent owner cannot under any circumstances or in any manner place a restriction, which will be enforceable under the patent law, upon the use to which a purchaser may put a device which has been made and sold under the patent.

We do not agree with this proposition of law. We believe the law to be that reasonable restrictions limiting the field of use of a patented device are enforceable under the patent law against a purchaser with notice. They have never been held otherwise. However, this point is not involved in this case because here, as we have seen, the

[1] I, 65. See the lease, II, 735.

sale to petitioner was not a sale *under* the patents, but a sale *in infringement* of the patents, brought about by petitioner's connivance with the Transformer Company, with full knowledge of all the facts. Therefore, we shall postpone our discussion of petitioner's proposition of law until after we have dealt with the issue actually presented by the facts in this case.

A.

The fact that the amplifiers in question were sold to petitioner by the American Transformer Company, which had a license under the patents in suit, does not excuse petitioner's infringement of those patents because that sale was outside of the Transformer Company's license, as both petitioner and the Transformer Company knew at the time. The Transformer Company's sale was itself an infringement and therefore could not confer upon petitioner any right or license under the patents.

As this Court said in *Bloomer* v. *McQuewan*, 14 How. 539, 549:

> "The franchise which the patent grants, consists altogether in the right to exclude everyone from making, using, or vending the thing patented, without the permission of the patentee. This is all that he obtains by the patent."[1]

A license is a mere permission granted by the patentee—a "mere waiver of his right to sue", *DeForest Radio Telephone Co.* v. *United States*, 273 U. S. 236, 242. If a licensee "performs an act in reference to the licensed invention which his license does not authorize * * * he is guilty of infringement". *Robinson on Patents*, Sec. 916.

[1] See also the full discussion in the *Paper Bag Patent Case*, 210 U. S. 405, 423, *et seq.*

"Any sale beyond the terms of the license is an infringement." *L. E. Waterman Co.* v. *Kline, et al.*, 234 Fed. 891, 893 (C. C. A. 4).

Thus, if the license grants permission to use a patented process for one purpose only, the licensee is liable as an infringer if he uses it for another purpose. *Rubber Co.* v. *Goodyear*, 9 Wall. 788, 799.

Similarly, as was stated by this Court in *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490:

> "• • • The patentee may make and grant a license to another to make and use the patented articles, but withhold his right to sell them. The licensee in such a case acquires an interest in the articles made. He *owns* the material of them and may use them. But if he *sells* them, he infringes the right of the patentee, and may be held for damages and enjoined."

So also, if a license gives the licensee permission to make the patented thing and to sell it only within a particular territory, the licensee would be an infringer if he went into another territory and *there* sold the patented thing. Or, if the license gives the licensee permission to make devices covered by a patent and to sell them "for use only in connection with and as part of" machines of a specified type, the sale of those devices by the licensee as part of machines of a different type is an infringement. *Vulcan Mfg. Co.* v. *Maytag Co.*, 73 F. (2d) 136, 138 (C. C. A. 8).

Similarly where, as here, the license gives the licensee permission to make the patented devices and to sell them only for specified uses, their deliberate sale by the licensee *for an entirely different use*, is an infringement.

There can be no doubt of the correctness of the finding of the Circuit Court of Appeals that the Transformer Company's deliberate and unauthorized sale of amplifiers to petitioner for use in talking picture theatres, was "an infringement and not a licensee's lawful sale".[1]

It follows that petitioner, which was fully conversant with all of the facts and which conspired with the Trans-

[1] III, 1724.

former Company in causing it to exceed the bounds of its license, acquired no rights under the patents with regard to those amplifiers by virtue of its purchase of them from the Transformer Company. Petitioner's subsequent leasing of those amplifiers to talking picture theatres was just as much an infringement of those patents as if petitioner had purchased them from someone who had no license at all, or as if petitioner had made them itself. Indeed, in view of petitioner's conspiracy with the Transformer Company in bringing about the infringing sale by that company to it it is liable for that infringement, jointly with the Transformer Company, as well as for its own subsequent infringing use of the amplifiers.[1]

Petitioner's argument on this point is fallacious:

In its statement of facts,[2] petitioner correctly states that the Transformer Company's license under the patents in suit was a license—

> "'to manufacture * * * and to sell *only* for radio amateur reception, radio experimental reception, and radio broadcast reception * * *' (Vol. I, pp. 332-335; Vol. III, p. 1415)".

For the reasons just stated, we cannot ignore the limited character of this license to sell, or the fact that the Transformer Company's sale of amplifiers to petitioner was known by both of them to be outside of the scope of that license. In our view, those facts dispose completely of the defense of non-infringement in this case.

Yet petitioner persists in blinking these facts. For example, in its statements of Point I and Point II,[3] concern-

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[1] Petitioner refers (Brief, p. 41) to the fact that respondents did not also sue the Transformer Company. That was not necessary. Since the Transformer Company and petitioner were both infringers, jointly and severally, either or both could be sued. Respondents chose to sue petitioner which was in direct competition with the business of the licensed respondents in their exclusive field.

[2] Brief, page 4.

[3] Brief, pages 13 and 22.

ing the alleged effect of the sale of a patented article which has been made "under the patent", petitioner avoids saying whether the sale it is talking about was made "*under* the patent", or *in infringement* of the patent, as in this case.

Similarly, in its heading on page 15, it speaks of the sale of a patented article by a licensee having "*a* power of sale", but avoids saying whether the sale to which it is referring is within the licensee's power of sale, or is outside of it, as in this case. And in supposed connection with our position that the sale of the amplifiers to petitioner, being outside of its vendor's power of sale, carried with it no rights under the patents in suit, petitioner says:[1]

> "In the first place the fact that the licensee undeniably had the right to *sell* is a complete answer." (Emphasis is petitioner's).

That is no answer at all because it is untrue with respect to the sale to petitioner. The whole point is that *the vendor had no right to make this particular sale, as both it and petitioner knew.*

The situation is no different from that which might arise in the case of a licensee who had a license to sell only five machines. If such a licensee, after selling the five machines under his license, sold another one to a person who knew of the limitation of the license and that the license was being exceeded, that sale and the purchaser's subsequent use of the machine, would be infringements. As already noted, "any sale beyond the terms of the license is an infringement". *L. E. Waterman Co.* v. *Kline, et al.*, 234 Fed. 891, 893.[2] And an infringing sale carries with it no rights under the patent.

Petitioner also seeks to get some comfort out of its assertion that[3] "to each amplifier made and sold by it to petitioner, there was attached a 'license notice' precisely as set forth in its license agreement with respondents".

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[1] Brief, page 34.

[2] *Supra*, page 13.

[3] Brief, page 34.

So far as the present point is concerned, the fact that "license notices" were attached to the amplifiers is of no moment whatever. The Transformer Company's license agreement provided:[1]

> "5. The Licensee shall affix to all Licensed Apparatus manufactured and *sold by the Licensee under the terms of this Agreement*, a license plate reading:
>
> " 'Licensed only for Radio Amateur, Experimental and Broadcast Reception' * * *."

But petitioner's amplifiers were *not* "sold by the Licensee under the terms of this Agreement". They were sold *outside* of the terms of the agreement. It did no good for the Transformer Company to *pretend* that they were sold under the terms of the agreement by attaching to them the "license notice" required by the agreement for licensed sales.

Nor does the following assertion by petitioner advance its argument in the slightest:[2]

> "* * * If the licensee, in exercising his right to sell, is claimed, nevertheless to have breached some express covenant in his license agreement, the remedy —and the only remedy—of the licensor lay in a suit against the licensee because of the breach. No cause of action—and certainly not one under the patent law—would lie against the purchaser."

We are not relying here on any breach of covenant by the Transformer Company. Our claim is that in selling the patented amplifiers to the petitioner for use in talking picture equipment for theatres, that company made a sale which the patent owner had not granted it permission to make, and which was therefore an infringement. Accordingly, the fact that petitioner acquired the amplifiers by virtue of that sale affords no defense to the charge of infringement in this case against petitioner for its own infringing use of the amplifiers.

Petitioner refers to the lower court decision in *Mitchell* v. *Hawley*, 11 Fed. Cas. 883, 885 (Case No. 6250).[3] In that

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[1] III, 1418, paragraph 5.

[2] Brief, page 34.

[3] Brief, page 35.

case the court was considering the question of whether the purchaser of a patented machine was liable as an infringer for using the machine during the extended term of the patent.[1] It held that he was, since his vendor was a licensee under a restricted license which "expressly provided that he shall not, in any way or form, dispose of any license to use the machines beyond the third day of May, 1867", that being the date of expiration of the original term of the patent, and "he clearly could not convey any greater rights than he possessed". The decision of the Circuit Court was affirmed by this Court (*Mitchell* v. *Hawley*, 16 Wall. 544). Instead of support-

[1] The term of the patent had been extended under the provisions of Sec. 18 of the Patent Act of 1836 (5 Stat. at large 117) then in force, which read:

"Section 18. *And be it further enacted.* That whenever any patentee of an invention or discovery shall desire an extension of his patent beyond the term of its limitation, he may make application therefor, in writing, to the Commissioner of the Patent Office, setting forth the grounds thereof; * * *. And if, upon a hearing of the matter, it shall appear to the full and entire satisfaction of said board, having due regard to the public interest therein, that it is just and proper that the term of the patent should be extended, by reason of the patentee, without neglect or fault on his part, having failed to obtain, from the use and sale of his invention, a reasonable remuneration for the time, ingenuity, and expense bestowed upon the same, and the introduction thereof into use, it shall be the duty of the Commissioner to renew and extend the patent, by making a certificate thereon of such extension, for the term of seven years from and after the expiration of the first term; * * * and thereupon the said patent shall have the same effect in law as though it had been originally granted for the term of twenty-one years. *And the benefit of such renewal shall extend to assignees and grantees of the right to use the thing patented, to the extent of their respective interests therein* [Italics ours]: *Provided however* [Italics in original], That no extension of a patent shall be granted after the expiration of the term for which it was originally issued."

ing petitioner's argument the case is clear authority against it, as was held by both of the courts below.[1]

Petitioner's fragmentary quotation from the lower court's decision in that case,[2] tends to convey exactly the opposite meaning from that intended by the court. In that portion of its opinion the court was drawing a contrast between the situation as it actually existed, with the vendor a restricted licensee, and the situation which would have existed if the vendor had been "a territorial *assignee*" of the original patent, *i. e.*, the *owner* of that patent for a given territory. Being only a restricted licensee, the court said (p. 885):

> "He had no power to sell a machine so as to take it out of the monopoly of the patent."

But, the court continued—and in this quotation we have italicised the words for which petitioner substituted asterisks—

> "Had he *been a territorial assignee and* possessed the power to sell the patented machines, the purchaser would have acquired a title which would have been outside of the monopoly, and would have acquired the absolute right to use the machines during the extended term; and this notwithstanding any covenants Bayley might have made not to convey such a title. Under such circumstances, the patentee must have sought his remedy against Bayley on his covenants."

Under these circumstances, the patentee would have had to pursue his remedy against the vendor on his covenants because a territorial *assignee*, being the owner of the patent for that territory and having, therefore, an absolute right to sell the patented machines in that territory, could not have *infringed* the patent by any sale made *within* that territory, no matter how unrestricted the sale might have been.

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[1] III, 1724, 1630. And see our further discussion of the case, *infra*, pages 29, 38-42.

[2] Brief, page 35.

But that has no bearing on this case, where petitioner's vendor was not a territorial assignee under the patent, but only the holder of a limited license, and where its sale to petitioner was outside of its license and therefore an infringement. There can be no valid excuse for petitioner's omission of the essential words from the above quotation.

The cases of *Adams* v. *Burke*, 84 U. S. (17 Wall.) 453, *Hobbie* v. *Jennison*, 149 U. S. 355, and *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, cited at page 37 of petitioner's brief emphasize still further, the difference between a territorial assignee, and the holder of a limited license to sell. In each of those cases the vendor was a territorial *assignee* of the patent, and had made an *absolute and unrestricted sale of the patented device within his own territory, as he had a perfect right to do, in view of his ownership of the patent for that territory.*[1] In the first and last of these cases the defendants (alleged infringers) were the persons who had purchased the patented devices from the territorial assignees by sales of that character, and had then proceeded to use or sell them outside of their vendor's territory. In the second of these cases (*Hobbie* v. *Jennison*), the suit was against the territorial assignee himself, who had made an absolute sale of patented articles in his territory, with knowledge that they were to be used elsewhere by the purchaser. In each case it was held that there had been no infringement. In making the *unrestricted* sale, *within* his territory, the territorial assignee had done only what he had a right to do under the patent. The patented articles had been "lawfully made and *sold*",[2] *i. e.*, sold *under* the patent because sold *within* the territory covered by the assignment.

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[1] At pages 35 to 37 of its brief petitioner misconstrues these cases in assuming that the vendor's "right to sell" was restricted.

[2] *Adams* v. *Burke*, 17 Wall. 453, 457; *Hobbie* v. *Jennison*, 149 U. S. 355, 363.

The distinction between these cases and the present one is clear. For, as we have said, the vendor in the present case was not an assignee of the patents, territorial or otherwise, but only the holder of a limited license under them; and its sale to petitioner, instead of being a "lawful" sale, was beyond the terms of its license and therefore "an infringement and not a licensee's lawful sale".[1]

Neither the case of *Straus* v. *Victor*, 243 U. S. 490, nor the *Motion Picture Patents* case, 243 U. S. 502, both of which are cited at page 38 of petitioner's brief, has any bearing upon the present question.

The first of these cases stands for the proposition that the patent law does not give a patent owner the right to fix the resale price of his patented article, the second, that it does not give him the right to compel the purchaser of a patented machine sold under a patent, to use it only with *unpatented* supplies purchased from the patent owner. They are discussed more in detail later.[2]

The license of American Transformer Company affords no defense to the charge of infringement against petitioner in this case. For the Transformer Company's sale to petitioner was not *under* that license, but *outside* of it, as both of them knew. Therefore that sale, and petitioner's subsequent use, of the amplifiers, were just as clearly *infringements* of the patents, as if the vendor had had no license at all.

We come now to our discussion of the contention made by petitioner in its Points I and II.

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[1] Opinion of Circuit Court of Appeals in this case (III, 1724).

[2] *Infra*, pages 33, 36, 46.

B.

Reasonable restrictions of the character here involved, which limit the field of use of a patented device sold under the patent, are valid and enforceable under the patent law as against one who has purchased the device with knowledge of the restrictions. Therefore petitioner would have been an infringer even if the sale of the amplifiers to it had been *under* the patents in suit instead of *in infringement* of those patents.

This point of law would become germane to this case only if this Court should find that the sale of the amplifiers to petitioner was within the terms of the vendor's license. As we have already pointed out, the record shows that it was not, and the court below so found. Therefore, the point is moot. Our discussion of it, as in the Courts below, is by way of replying completely to petitioner's brief, which we feel compelled to do. This discussion will necessarily be of some length because of the nature of the point: *For the purpose of this discussion, and solely for this purpose, we shall disregard the fact—which itself disposes completely of the defense of non-infringement—that the sale of the amplifiers to petitioner was in infringement of the patents.*

In order to overcome the charge of infringement in this case, petitioner must show affirmatively that it had a license to use the amplifiers in question, in the field in which it used them, namely, in the commercial field of talking motion picture reproduction in theatres. For, as we have seen, petitioner admits that those amplifiers embody the inventions claimed in the patents in suit.[1] Peti-

[1] License is an affirmative defense to be established by the party asserting it. *Sherman, Clay & Co.* vs. *Searchlight Horn Co.*, 225 Fed. 497, 500; *Union Special Mach. Co.* vs. *Maimin*, 185 Fed. 120, 128.

tioner does not contend that it ever received an express license to use them in that field. On the contrary, at the trial petitioner's counsel stated that the amplifiers were sold to petitioner with the limited license to use them only for radio amateur, experimental, and broadcast reception. In this connection counsel said:[1]

> "• • • The apparatus was sold to us with that limited license of use, in accordance with the express terms of the American Transformer license, noticed right on the instrument itself."

Nevertheless, petitioner seeks to establish that it was licensed to use these amplifiers for the commercial reproduction of talking pictures in theatres, by contending that from a legal standpoint, the limitations of that express license were void *ab initio*, and that therefore petitioner acquired with the amplifiers an unlimited license to use them in any and all fields.

In support of this contention petitioner argues that the sale of a patented device under the patent, automatically and inevitably conveys to the purchaser, by implication, an unrestricted license to do what he will with the thing purchased, and that it is impossible for the patentee to overcome that implication even by a notice of the restrictions brought home to the purchaser at the time of the purchase. According to petitioner, the sale "exhausts the monopoly of the patent owner as to the particular article involved",[2] irrespective of any precautions that may be taken to avoid this result. In this connection, petitioner quotes general language from decisions by this Court about the sale of a patented article taking it out of the patent monopoly.

Later[3] we shall discuss these decisions and point out that the language which petitioner quotes from them had its origin in cases which did not involve *restricted* sales of patented articles, and that it should be un-

[1] I, 325.

[2] Brief, page 14.

[3] *Infra*, pages 37-49.

derstood as applying only to unrestricted sales. The only instances in which this Court has held restrictions imposed in connection with the sale of a patented device to be invalid are (1) where the restrictions sought to fix the resale price of the device, and (2) where they sought to compel the purchaser of the device to purchase from the patentee *unpatented* supplies required in the operation of the patented device. These restrictions were held invalid as against public policy—those of the first class because it was deemed undue restraint of trade to allow the vendor of an article, whether patented or unpatented, to dictate resale prices, and those of the second class because they attempt to include within the scope of the patent monopoly materials which are not covered by the patent.

Reasonable restrictions limiting the field of use of a patented device, such, for example, as the one in which we are interested in this case, do not fall within either of these classes and, as petitioner appears to concede,[1] *have never been held invalid.* They are not against public policy, or outside of the scope of the patent monopoly. In our view they are valid and enforceable against a purchaser with notice.

Public policy is not opposed to, and on the contrary distinctly requires, the enforcement of reasonable restrictions on the field of use of a patented device:

Restrictions of this character are beneficial to the public because they promote the purposes of the patent laws, make for fair dealing between the patentee and the public, and stimulate trade and the development of the arts. Frequently, as in this case, the value derivable from the commercial *use* of the patented device far outweighs the intrinsic value of the thing itself. Reasonable restric-

[1] Brief, page 10. There petitioner refers to the decisions of this Court merely as being "on closely *analogous* questions", and, on page 39, to the "*trend* of the decisions of this Court". On page 29, petitioner admits a distinction "in the *character* of the restrictions" involved, between the case at bar and this Court's decisions in the above two classes of cases.

tions limiting the field in which such devices may be used, make it possible for a patentee to sell them to the general public at reasonable prices, for use in other fields, while still retaining his exclusive rights in the particular commercial field in which he himself is using the invention.

Were it not possible for him to do this, he would have to elect between two alternatives. He would either have to increase his selling price to the public to an extent sufficient to compensate him for any resultant loss that he might suffer in his own field of use, or he would have to exercise to a greater degree the right of exclusion granted by his patent, and refrain from making or permitting *any* distribution of the patented devices to the general public, as he would have a perfect right to do.[1]

Neither of these alternatives would be advantageous to the public. The extra price which it would be necessary for the patentee to exact from every purchaser, under the first alternative, would, in many cases, be a payment for something that the purchaser did not want, since the purchaser would have no desire to use the patented device in the patentee's field. And under the second alternative, the general public would not be permitted to enjoy the invention until the expiration of the patent monopoly.

If, on the other hand, as we believe to be the case, reasonable restrictions limiting the field of use of a patented device are enforceable under the patent law, the public may acquire such devices freely, and *by paying only for what they want*. For example, a radio enthusiast may buy a patented amplifier for use in his home by paying a price which the patentee is willing to accept for such a sale, and without being required to pay for the privilege (which he does not want) of using it for commercial purposes. In our view it is far more important that the interests of the public generally should be served by making possible restricted sales of this kind, than it is to permit someone like this petitioner to acquire a patented amplifier at a price and under a license, which con-

[1] Paper Bag Patent Case, 210 U. S. 405, 425, *infra*, page 57.

template that it will be used only in the home, and then to use it in the field in which the patentee himself is commercializing the invention.

The view which we advocate is fair to the inventor and the public alike; it encourages and promotes trade, and it provides the incentive to invention and to the investment required for the development of inventions, which it was the object of the patent laws to create.

The authorities sustain the enforceability of express restrictions of the character here involved:

We agree fully with the proposition that an authorized sale of a patented device, made *without notice of any restriction*, gives to the purchaser an implied license to do with it as he will. To use petitioner's language, such a sale indeed "exhausts the monopoly of the patent owner as to the particular article involved". But when the sale is made with knowledge of a restriction limiting the field of use of the device, or other *reasonable restrictions actually within the scope of the patent monopoly*, the usual unrestricted license is replaced by an express restricted license. And if, thereafter, the purchaser exceeds the bounds of that restricted license, he is liable as an infringer.

Preliminary to our discussion of the authorities relating directly to the validity of these restrictions, we call attention to the following statement from *Bement* v. *National Harrow Co.*, 186 U. S. 70, 91 (the decision in which was reaffirmed in *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490):

> "• • • Notwithstanding these exceptions, the general rule is absolute freedom in the use or sale of rights under the patent laws of the United States. The very object of these laws is monopoly, and the rule is, with few exceptions, that any conditions which are *not in their very nature illegal* with regard to this kind of property, imposed by the patentee and agreed to by the licensee for the right to manufacture or use or sell the article, will be upheld by the courts."

It is from this point of view that the question of law now under discussion, should be considered. Unless the

restriction is in its "very nature illegal" it "will upheld by the courts". As we shall see, this rule has be consistently followed by the courts and under it restr tions upon the use of the patented thing itself, ha always been upheld.

The General Rule as Stated by the Authorities:

The true rule, as we have outlined it above, is w expressed in *Robinson on Patents,*[1] Sec. 824, as follows:

> "There are certain cases in which the law impli a license from the dealings of the parties with ea other, or from the relations which subsist betwe them. The most frequent and important of the cases arises when a patented article is sold by anyo who has a right to sell it. From such a sale the l implies a license to the purchaser, and to every su sequent owner of the article, to use it as long as identity can be preserved. This implied license re upon the principle that the owner of the patent invention, having once received his recompense releasing the article from the monopoly, either in price directly paid to him or in the license-fee whi he collects from its vendor, he can thereafter neith limit nor demand compensation for its use, but by t sale delivers it from all the restrictions of the pate and makes it common property like any other perso estate. To have that effect, however, the sale must a lawful and unconditional sale. * * * *Not only m the patentee impose conditions, limiting the use the patented article, upon his grantees and expre licensees, but any person having the right to sell m at the time of sale restrict the use of his vendee wit specific boundaries of time or place or method, a these will then become the measure of the impli license arising from the sale.* But when the sale unconditional, as is the case in ordinary sales authorized vendors in open market, the implied licen gives to the purchaser and his vendees the unrestrict

[1] Robinson has been recognized for years as the greate and most authoritative work on Patents and has been cit repeatedly by this Court. For example, Robinson is cit in *DeForest* v. *United States,* 273 U. S. 236, 242, on t subject of license.

right to use the article unless such use infringes some other patent than the one by which the article itself has been protected."

As Judge Wallace put it in *Holiday* v. *Mattheson*, 24 Fed. 185, 186 (C. C. S. D. N. Y.):

"* * * When the owner of a patent sells the patented article under circumstances which imply that the purchaser is not to acquire an unqualified property in the thing purchased, *as where a license accompanies the transfer*, the purchaser's rights are limited to the extent of the monopoly granted to him."

In *Dickerson* v. *Tinling*, 84 Fed. 192 (C. C. A. 8), a patentee, who owned both United States and foreign patents for a certain drug, had sold the patented drug in Germany to the defendant. Notice that the drug was not to be imported into or resold within the United States, appeared upon the packages containing the drug. The defendant was held liable as an infringer having resold the drug in the United States. The court stated the rule as follows (p. 195):

"* * * there can be no doubt that a patentee has the same right and power to sell the patented article upon conditions or with restrictions that he has to sell it at all. * * * If the corporation sold the patented article subject to such a restriction, the purchasers, with a notice of this limitation, whether immediate or remote, could acquire no better right than strangers to infringe upon the monopoly secured by the patent."

In *Dickerson* v. *Matheson, et al.*, 57 Fed. 524 (C. C. A. 2), the same ruling had previously been made upon a similar state of facts.

The Court of Appeals for the Second Circuit in *General Electric Co.* v. *Continental Lamp Works*, 280 Fed. 846 (a case decided long after this Court's decisions upon which petitioner relies, *infra*, p. 37), held that the sale by the plaintiff of bases for electric lamps did not carry with it a license under the plaintiff's lamp patents, in view of notice to that effect brought home to the purchaser at the time of his purchase. The court said (p. 851):

"Use of an invention can only be obtained on the inventor's terms. Without paying or doing what-

ever he exacts, no one can be exempt from his right to exclude, and, whatever the terms, the courts will enforce them, provided only that the licensee is not thereby required to violate some law outside of the patent law. * * *

"So, where the owner of a patent sells a patented article subject to a restriction, the purchasers, with notice of this limitation, could acquire no better right than strangers to infringe upon that part or claim of the monopoly still secured to the patentee" (citing *Dickerson* v. *Tinling, supra*).

The same rule obtains in England. Thus it is said in *Terrell on Patents*, 8th Edition, 1934, the leading English textbook authority (p. 273):

"A purchaser of patented goods without notice of restrictions affecting such goods is free to use and sell them in any way he chooses,[1] but if he has such notice at the time of his purchase and contravenes such restrictions he is liable to be sued for infringement by the patentee, as the restrictions are *'not contractual but are incident to and a limitation of the grant of the license to use*, so that, if the conditions are broken, there is no grant at all'.[2]

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[1] Citing *Betts* v. *Willmott*, L. R. 6 Ch. App. 239, at p. 245; *Incandescent Gas Light Co., Ltd.* v. *Cantelo*, 12 R. P. C. 262; *Incandescent Gas Light Co., Ltd.*, v. *Brogden*, 16 R. P. C. 179; *Scottish Vacuum Cleaner Co., Ltd.* v. *Provincial Cinematograph Theatres, Ltd.*, 32 R. P. C. 353 (O. H.).

[2] Citing Farwell, *J.*, in *British Mutoscope & Biograph Co., Ltd.* v. *Homer*, 18 R. P. C. 177, at p. 179; see also *National Phonograph Co. of Australia, Ltd.* v. *Menck*, 28 R. P. C. 229 (P. C.) at p. 248; see also *Columbia Phonograph Co. General* v. *Regent Fittings Co.*, 30 R. P. C. 484; *Columbia Graphophone Co.* v. *Vanner*, 33 R. P. C. 104; *Columbia Graphophone Co., Ltd.* v. *Murray*, 39 R. P. C. 239; *Columbia Graphophone Co., Ltd.* v. *Thoms*, 41 R. P. C. 294.

The English case of *Taddy* v. *Sterious*, L. R. (1904) 1 Ch., 354, cited on page 35 of petitioner's brief, related to a resale price restriction on *unpatented* articles. The above cases in this footnote, cited by Terrell, are the controlling English cases enforcing restrictions on *patented* articles after sale.

"The question of the knowledge of the defendant is one of fact in each case, as to which the passing of some leaflet or label with the goods at the time of sale may or may not be sufficient evidence according to the nature of the goods and the general circumstances. It is not essential that the purchaser should have knowledge of the precise restrictions concerned so long as he has knowledge of their nature and existence and means of knowledge of their exact extent."[1]

Decisions Applying the Rule to Restrictions upon the Use of the Patented Device Itself:

In every case with which we are familiar where it has been necessary to pass upon *restrictions upon the use of the patented device itself,* the rule stated in the above quotations has been followed, and the restrictions held valid and enforceable under the patent law.

The only case in which this Court has been required to pass directly upon restrictions of this character is *Mitchell* v. *Hawley,* 16 Wall. 544, previously referred to.[2] The restriction there in question limited the time during which the patented machines could be used. It permitted their use only during the original term of the patent. The defendant had purchased the machines from a licensee *whose license did not permit him to grant the right to use them beyond that term.* The purchaser was held *chargeable with knowledge* of the limited character of his vendee's rights. The patent term was extended under the provisions of the Patent Statute then in force.[3] The purchaser continued to use the machines after the expiration of the original term. *This Court held that such use exceeded the right to use, acquired by the purchaser, and was an infringement.* It was argued in that case (p. 546) that

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[1] Citing *Columbia Graphophone Co., Ltd.* v. *Murray,* 39 R. P. C. 239; cf. *Badische Analin und Soda Fabrik* v. *Isler,* 23 R. P. C. 633 (C. A.).

[2] *Supra,* pages 16-19. [3] Quoted, *supra,* page 17.

the sale "operated to take *the thing sold* out of the reach of the Patent Act altogether, and that as long as the machines themselves lasted, the owner could use them"—the same argument that is urged upon the Court in the present case. The Court decided against the defendant, nevertheless, for the reasons stated above. And the Court, distinguishing *Bloomer* v. *McQuewan*, 14 How. 549, here relied upon by petitioner, made clear its recognition of the rule that a sale made "without any conditions" would have had the effect for which the defendant was contending.[1]

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[1] The Court said, page 547:

> "• • • a patentee, when he has himself constructed a machine and sold it *without any conditions*, or authorized another to construct, sell, and deliver it, or to construct and use and operate it, *without any conditions*, and the consideration has been paid to him for the thing patented, the rule is well established that the patentee must be understood to have parted to that extent with all his exclusive right, and that he ceases to have any interest whatever in the patented machine so sold and delivered or authorized to be constructed and operated.";

also, that the purchaser of a machine *under such circumstances*

> "may continue to use it until it is worn out, in spite of any and every extension subsequently obtained by the patentee or his assigns."

And, the Court cites in this connection *Bloomer* v. *McQuewan*, 14 How. 549, and *Chaffee* v. *Boston Belting Co.*, 22 How. 223, cases which so hold. But the Court said further (p. 548), that

> "*Sales* of the kind may be made by the patentee *with or without conditions* • • •"

and, since, in the case before the Court, the right granted to the maker of the machines had been expressly limited by the license contract so that he could not license the use of them beyond the expiration of the original patent, the Court enjoined as an infringement, the further use of the machines.

This decision has never been overruled by this Court. It has been cited frequently by this Court, and has been followed in many decisions of the lower courts, for example, in *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536 (C. C., D. Mass., Lowell, *J.*) in which another restriction upon the duration of the permitted use was upheld. In that case, the court construed the document before it as a sale of certain patented machines conditioned upon payment of royalty up to a certain date, without the right to use the machines thereafter unless some further agreement should be made. After the stipulated period had expired, no new agreement having been made, the court enjoined the use of the machines and said (p. 537):

> "We agree that the words, 'the said seven machines are valued at $800, the receipt of which is acknowledged,' import a sale of the machines; and that an absolute and unqualified sale of a patented machine carries with it the right of use. But the mere value of a patented machine is often, and is proved to be in this case, insignificant in comparison with the value of its use; and the courts have permitted a severance of ownership and right of use, if the patentee has chosen to dissever them, and if his intent is not doubtful. For instance: a license to use a machine implies the right to make and own it; and yet, if the owner neglects to pay the license fee, he may be restrained from using a machine to which his title is undoubted. One who is licensed to make, use, and sell machines for the term of the patent, and no longer, sells a machine with the right to use it. The purchaser owns the machine, but if the patent is extended, he has no right to use it, during the extended term, without a further license from the patentee. *Mitchell* v. *Hawley*, 16 Wall. 544. In many other cases the ownership of the machine will not necessarily carry with it the right to use it without the permission of the patentee."

In *Skee Ball Co.* v. *Cohen*, 286 Fed. 275 (D. C. E. D. N. Y.), a case decided long after the decisions of this

Court that are relied upon by petitioner, the court upheld a restriction imposed at the time of sale, limiting the use of the patented skee ball alley, to a prescribed area. The purpose of the restriction was to prevent destructive competition between licensees.

Decisions of this Court Establishing Exceptions to the General Rule:

As we have previously stated, only two specific exceptions have been established to the general rule as to the enforceability of restrictions brought home to the purchaser at the time of his purchase of a patented device. They are (1) restrictions attempting to fix the resale price, and (2) restrictions seeking to compel the purchaser to purchase unpatented supplies from a specified source.

(1) *Restrictions fixing the Resale Price:*

The case which established this exception to the general rule, with regard to patented articles is *Bauer* v. *O'Donnell*, 229 U. S. 1 (the "*Sanatogen*" case), in which the maker of a patent medicine attempted, by notice appearing upon the containers, to fix the price at which retailers purchasing it from him or from his dealers might sell it. In *Bobbs-Merrill Co.* v. *Straus*, 210 U. S. 339, the Court had held that restrictions fixing the resale price of copyrighted books could not be enforced under the copyright laws. In the *Bauer* v. *O'Donnell* case, it applied the same doctrine to the patent laws. The Court said (pp. 11, 12):

> "The object of the notice is said to be to effectually maintain prices and to prevent ruinous competition by the cutting of prices in sales of the patented article. That such purpose could not be accomplished by agreements concerning articles not protected by the patent monopoly was settled by this court in

> the case of *Dr. Miles Medical Co.* v. *Park & Sons Co.*, 220 U. S. 373, in which it was held that an attempt to thus fix the price of an article of general use would be against public policy and void. It was doubtless within the power of Congress to confer such right of restriction upon a patentee. Has it done so?"

Then, after discussing the patent statute (and comparing it with the copyright statutes), the Court concluded that it must answer this question in the negative.

Thus the holding of *Bauer* v. *O'Donnell* is merely that there is nothing in the patent law that can save an attempt to fix resale prices of patented articles from the rule of public policy applicable to such attempts in the case of unpatented articles.

This doctrine was reaffirmed in *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490,[1] and *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8. It is not applicable in any way to the present case.

(2) *Restrictions relating to Unpatented Supplies to be Used with a Patented Machine:*

The decision which established this exception is *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502. It specifically overruled *Henry* v. *Dick*, 224 U. S. 1, which had held that the general rule to which we have referred was applicable even to restrictions which apply not to the use of the machine that is covered by the patent, but to supplies not covered by that patent.

In this *Motion Picture* case a motion picture machine was sold by a licensee of the plaintiff (patent owner) with a notice that it could be used only with films leased from licensees of the plaintiff and containing the invention

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[1] In *Straus* v. *Victor Talking Machine Co.* an attempt had been made to avoid the principle announced in *Bauer* v. *O'Donnell* by cloaking what was really a sale in terms indicating a mere license to use; but the Court looked through this disguise and treated the transaction as what it really was, a sale.

covered by another of plaintiff's patents (which had expired). The specific question considered by this Court was (p. 508):

> "May a patentee or his assignee license another to manufacture and sell a patented machine and by a mere notice attached to it limit its use by the purchaser or by the purchaser's lessee, to films *which are no part of the patented machine, and which are not patented?*"

In answering this question in the negative, the Court placed its decision squarely on the ground that the patent law does not grant any monopoly *except a monopoly of the invention which the claims of the patent cover,* and that to allow a patentee, by such a restriction as to the use of supplies with his patented machine, to extend his monopoly to include articles not covered by the patent, is an unjustified restraint of trade and against public policy.

Thus the Court said (p. 518):

> "Such a restriction is invalid *because such a film is obviously not any part of the invention of the patent in suit;* because it is an attempt, without statutory warrant, to continue the patent monopoly in this particular character of film after it has expired, and because to enforce it would be to create a monopoly in the manufacture and use of moving picture films, *wholly outside of the patent in suit and of the patent law as we have interpreted it.*"

This statement alone makes it clear that the Court was confining its condemnation to restrictions of the character there before it, and that it had no intention of condemning restrictions, such as these here involved, upon the use of the patented machine itself. At other points in the opinion, this distinction is brought out even more forcibly. For example, at page 512, after referring to R. S. § 4884 which provides that every patent "shall contain • • • a grant to the patentee, his heirs or assigns • • • of

the exclusive right to * * * use * * * the invention or discovery", the Court said:

> "Plainly, this language of the statute and the established rules to which we have referred restrict the patent granted on a machine, such as we have in this case, to the mechanism described in the patent as necessary to produce the described results. It is not concerned with and has nothing to do with the materials with which or on which the machine operates. The grant is of the exclusive right to use the mechanism to produce the result with any appropriate material, and the materials with which the machine is operated are no part of the patented machine or of the combination which produces the patented result. *The difference is clear and vital between the exclusive right to use the machine which the law gives to the inventor and the right to use it exclusively with prescribed materials to which such a license notice as we have here seeks to restrict it.* The restrictions of the law relate to the useful and novel features of the machine which are described in the claims of the patent, they have nothing to do with the materials used in the operation of the machine; while the notice restrictions have nothing to do with the invention which is patented but relate wholly to the materials to be used with it. Both in form and in substance the notice attempts a restriction upon the use of the supplies only and it cannot with any regard to propriety in the use of language be termed *a restriction upon the use of the machine itself.*"

It seems obvious that if this Court in its earlier decision in *Bauer* v. *O'Donnell*, 229 U. S. 1, *supra*, (holding resale price restrictions invalid) had meant to hold, as petitioner implies, that *all* restrictions accompanying the sale of a patented device were invalid, it would not have placed this *Motion Picture* decision on the ground that the particular restrictions before it were restrictions "upon the use of supplies only" and not "upon the use of the machine itself." A mere statement of the broad proposition for which petitioner now contends would have sufficed. The great care

that this Court took in this decision to distinguish between these two different kinds of restrictions, indicates definitely that neither the *Bauer* v. *O'Donnell* decision nor this one, was intended to change the general rule as to the enforceability of restrictions, such as we have in the case at bar, which are actually "upon the use of the machine itself" and therefore *clearly within the patent monopoly.*

The *Motion Picture* case, and also the more recent *Carbice* case (*Carbice Corp.* v. *American Corp.*, 283 U. S. 27, and on rehearing page 420[1]), by drawing a sharp distinction between restrictions on the use of unpatented supplies and restrictions relating to the use of the patented machine itself, constitute a most persuasive argument for the validity of the restriction here involved and are in accord with the authorities upon which we rely.

The restriction in the instant case comes under the general rule and is enforceable:

The restriction involved in this case, limiting the field in which the patented amplifiers may be used, is a restriction *upon the use of the patented machine itself.* Therefore, it falls within the general rule and is enforceable under the patent law.

Independent Wireless Telegraph Co., et al. v. *Radio Corp. of America, et al.*, 269 U. S. 459, which came here on a question of joinder of parties, is of interest on this point. The defendant had purchased patented vacuum

[1] Petitioner merely cites (Brief, p. 28) the *Carbice* case as being to the "same effect" as the *Motion Picture* case. In the opinion on rehearing in the *Carbice* case this Court stated (p. 421) that in the first decision "we held that the bill should be dismissed on the ground that the owner of a patent may not limit its use so as to require that *unpatented* materials employed in practicing the invention shall be purchased from the licensor * * *". See also pages 31 to 33 of the first opinion discussing the *Motion Picture* case and basing the decision squarely on that case.

tubes to which were applied exactly the same restrictive notice as to field of use, that we are considering in this case. The infringement charged was the defendant's use of those vacuum tubes in the commercial field of radio communication between ship and shore for pay which was outside of the licensed field. The Court was not required to pass upon the validity of that restriction and did not do so. But in the statement of the case this Court did not suggest any doubt that it was valid. The Court said (p. 461):

> "• • • there came from the DeForest Company to the Radio Corporation, exclusive rights to use and sell in the United States, for radio purposes, apparatus for transmission of messages, and especially for use between ship and shore for pay.
>
> *"The defendant, the Independent Wireless Company, has bought the same apparatus with the lawful right to use it in the amateur and experimental field only.* The apparatus thus bought bears a label with such a limitation on its use. The charge in the bill is that the Independent Company is using the apparatus, or the part of it called 'radio tubes', in the commercial radio field between ship and shore for pay and thus is violating the Radio Corporation's rights in this field."

The statement that defendant bought the apparatus *"with the lawful right to use it in the amateur and experimental field only"* is believed to be significant.

The Decisions Relied upon by Petitioner:

As we have indicated, petitioner's primary reliance in support of its contention that the restriction which we are considering, is invalid and unenforceable even against a purchaser with notice, is upon broad language used by this Court to the effect that the authorized sale of a patented device takes it outside of the patent monopoly. Petitioner seeks to construe this language as meaning that there is nothing that the patentee can do to prevent this result; that the implication that an unrestricted license

goes with the passage of title cannot be overcome in any way, not even by specific notice to the purchaser at the time of the sale that only a restricted license is granted.

We do not believe that this Court ever intended the language in question to be interpreted as broadly as this but quite the contrary. Construed in the light of the cases in which it originated, we believe that this language should be confined to unrestricted sales, which concededly have the effect stated.

1. *Cases relating to Time of Use:*

The cases of this character to which petitioner refers,[1] like *Mitchell* v. *Hawley,* 16 Wall. 544,[2] involved questions arising out of extensions of the term of patents, under Section 18 of the Patent Act of 1836, or special Acts of a similar character.[3] The decisions in the first two of these cases, cited by petitioner, *Wilson* v. *Rousseau,* 4 How. 646 and *Simpson* v. *Wilson,* 4 How. 709, were confined to an interpretation of this particular Section of the Act of 1836. They held that the benefit of an extension obtained under it did not inure to one who was a *territorial assignee* for the original term of the patent because the purpose of the Act was to benefit the inventor and not his assignees, but that the last sentence of the Section meant that one who had purchased a patented machine in the ordinary course (*i. e.* without any restriction as to the length of time it could be used) from the patent owner during the original term, could continue to use it during the extended term (p. 684).[4] These decisions, confined as they are to the interpretation of a particular

[1] Brief, pages 16-18.

[2] *Supra,* pages 16-19, 29. [3] *Supra,* page 17.

[4] It will be recalled that the last sentence of the statute expressly provided that "the benefit of such renewal shall extend to *assignees and grantees of the right to use* the thing patented, to the extent of their respective interests therein."

statute, give no support to petitioner's proposition that "the sale of a patented chattel exhausts the patent rights of the seller".[1]

The first of the cases from which petitioner quotes in attempting to support this proposition is *Bloomer* v. *McQuewan*, 14 How. 539. *It is the first case in which this Court used the broad language upon which petitioner relies.* The respondents had purchased the right to construct and use certain patented machines, *without limitation.* They had constructed some of those machines, and continued to use them after the expiration of the original term of the patent. The term of the patent was extended by a special Act of Congress. The patent owner sought to enjoin respondents' further use of these machines.

Under the general provisions of the Act of 1836 relating to extensions of patents[2] respondents would have had the right to continue to use these machines during the extended term because they had previously acquired an unlimited "right to use" them. *Wilson* v. *Rousseau*, 4 How. 646, *supra.* The question before the Court was whether that same situation obtained under the special Act under which this particular patent had been extended. The Court held that it did, finding that Congress intended the special Act to be subject to the general provisions of Section 18 of the Act of 1836. The Court said (pp. 553, 554):

> "The right to construct and use these planing machines, had been purchased and paid for without any limitation as to the time for which they were to be used. They were the property of the respondents. Their only value consists in their use. And a special act of congress, passed afterwards, depriving the appellees of the right to use them, certainly could not be regarded as due process of law.
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> . . . . . .

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[1] Brief, page 17.

[2] *Supra*, page 17. See particularly the sentence of this Act quoted in footnote 4 on hte preceding page.

> "* * * we are of opinion that this special act of congress does not, and was not intended to interfere with rights of property before acquired; but that it leaves them as they stood during the extension under the general law [relating to extensions]."

Accordingly, the injunction sought by the patent owner was denied. The Court's reference to the effect of a *sale*, which petitioner quotes,[1] was merely by way of repeating the reason given in *Wilson* v. *Rousseau*, *supra*, for the holding that the last sentence of Section 18 of the Statute of 1836 applied to ordinary (unrestricted) purchasers of machines during the original term of the patent, but not to territorial assignees or grantees of the patent. The Court's entire statement in this regard (of which petitioner has quoted only the last paragraph) is as follows (p. 549):

> "Now, the act of 1836, in express terms, gives the benefit of the extension authorized by that law to the assignees and grantees of the right to use the thing patented to the extent of their respective interests therein. And under this provision it was decided, in the case of *Wilson* v. *Rousseau*, 4 Howard 688, that the party who had purchased and was using this planing machine during the original term for which the patent was granted, had a right to continue the use during the extension. And the distinction is there taken between the grant of the right to make and vend the machine, and the grant of the right to use it.
>
> "The distinction is a plain one. The franchise which the patent grants, consist altogether in the right to exclude every one from making, using, or vending the thing patented, without the permission of the patentee. This is all that he obtains by the patent. And when he sells the exclusive privilege of making or vending it for use in a particular place, the purchaser buys a portion of the franchise which the patent confers. He obtains a share in the monopoly, and that monopoly is derived from, and ex-

[1] Brief, page 17.

ercised under, the protection of the United States. And the interest he acquires, necessarily terminates at the time limited for its continuance by the law which created it. The patentee cannot sell it for a longer time. And the purchaser buys with reference to that period; the time for which exclusive privilege is to endure being one of the chief elements of its value. He therefore has no just claim to share in a further monopoly subsequently acquired by the patentee. He does not purchase or pay for it.

"But the purchaser of the implement or machine for the purpose of using it in the ordinary pursuits of life, stands on different ground. In using it, he exercises no rights created by the act of congress, nor does he derive title to it by virtue of the franchise or exclusive privilege granted to the patentee. The inventor might lawfully sell it to him, whether he had a patent or not, if no other patentee stood in his way. And when the machine passes to the hands of the purchaser, it is no longer within the limits of the monopoly. It passes outside of it, and is no longer under the protection of the act of congress."

This last paragraph must be construed with its context and in light of the provision of the statute which gave to those who had previously acquired "the right to use" a machine "the benefit of the renewal". As so construed, it is clearly confined to the effect of ordinary *unrestricted* sales, *as was subsequently held in Mitchell v. Hawley*, 16 Wall. 544, *upon which we rely*.[1] The statement has nothing to do with sales of the character with which we are here concerned, namely, sales accompanied by notice to the purchaser that he receives with the machine only a limited license to use it.

It should also be observed that the *Bloomer* case did not involve a sale of the patented machines but merely the license or "right to construct and use" those machines, as stated in the opinion.[2] Therefore, there was no occasion

[1] *Supra*, pages 16-19, 29. [2] *Supra*, page 39.

for the Court to discuss the effect of such a sale and the statement made is in fact a *dictum*. Nor should it be forgotten that this was the first case in which the Court used the broad language upon which petitioner relies and that the decision was based on the express provision of the Act of 1836 that gave the benefit of patent extensions to all persons who had before acquired the "right to use the thing patented".[1]

The two *Wilson* cases and the *Bloomer* case are the only cases relating to time of use, which petitioner mentions. Petitioner makes no reference in this connection to the decision of this Court in the only such case which is really pertinent, namely, *Mitchell* v. *Hawley*, 16 Wall. 544. And that case, which is the latest of the group, holds, as we have seen, that restrictions limiting the time of use of the device are valid and enforceable against a purchaser who is chargeable with knowledge of those restrictions. Moreover, as we shall see, in every subsequent case in which this Court has used the broad language, which originated under the special circumstances in the *Bloomer* case, that language was unnecessary to the decision.

2. *Cases relating to Place of Use:*

The first of these cases relied upon by petitioner is *Adams* v. *Burke*, 84 U. S. 453, 459. In that case a Boston manufacturer was a territorial assignee of the patent for a coffin lid, having acquired from the patentees "all the right, title, and interest which the said patentees had in the invention described in the said letters-patent, for, to, and in a circle whose radius is ten miles, having the city of Boston as a center" (p. 458). He sold

[1] It is of considerable interest to note that the statute itself appears to recognize the difference between mere ownership of a patented article and the right to use it because it gave the benefit of the patent extension to any one who had "the right to use the thing patented" quite irrespective of his title to the thing itself.

one of those coffin lids *unconditionally* to the defendant *in* Boston, as he, being the assignee of the patent for that territory, had a perfect right to do. Defendant used that lid outside of the ten mile limit and was charged by the patentees with infringement for so doing. Since the defendant had bought it without condition from an assignee who had the right to make such a sale, this Court refused relief to the patentee. The Court specifically held that the lid had been "lawfully made and sold" (17 Wall. 453, 457). It is in the light of these facts that the following language quoted by petitioner[1] from this decision, must be construed:

> "But, in the essential nature of things, when the patentee, or the person having his rights, sells a machine or instrument whose sole value is in its use, he receives the consideration for its use and he parts with the right to restrict that use. The article, in the language of the Court, passes without the limit of the monopoly." (Note particularly that the Court here cites *both Bloomer* v. *McQuewan* and *Mitchell* v. *Hawley, supra.*)

As so construed, it clearly applies only to *unconditional* sales. Otherwise, the Court would not have taken the pains at the end of its opinion (p. 457) to point out that——

> "when they [patented devices] are once lawfully made and sold, there is no restriction on their *use*[2] to be *implied* for the benefit of the patentee or his assignees or licensees."

In the case at bar, we are not dealing with *implied* restrictions but with *express* restrictions of which the purchaser is notified at the time of the sale.

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[1] Brief, page 18.

[2] The word *use* is italicized in the original, but the word *implied* is not.

Hobbie v. *Jennison*, 149 U. S. 355, referred to by petitioner at page 18 of its brief, involved substantially the same state of facts and the same question as *Adams* v. *Burke, supra*. The only difference was that in this case the suit was brought against the territorial assignee rather than his vendee. The decision of the Court was the same. Since the territorial assignee had absolute title to the patent for his particular territory, it was held that he could sell the patented articles in that territory without imposing any restrictions upon the place where the purchaser might use them, and that he could do so even if he knew that the purchaser intended to use them outside of that territory. This defendant's right to vend in his particular territory, being unrestricted, is to be distinguished from the right to vend "*for use* in a particular place", to which this Court referred in *Bloomer* v. *McQuewan*.[1]

This *Hobbie* v. *Jennison* decision is of particular interest because of the Court's comment (pp. 363, 364):

> "It is easy for a patentee to protect himself and his assignees, when he conveys exclusive rights under the patent for particular territory. He can take care to bind every licensee or assignee, if he gives him the right to sell articles made under the patent, by imposing conditions which will prevent any other licensee or assignee from being interfered with. There is *no condition or restriction in the present case* in the title of the defendant."

This would seem to indicate very definitely that it is possible to impose effective restrictions upon the use of a patented device, at the time of its sale.

Keeler v. *Standard Folding Bed Co.*, 157 U. S. 659, which is cited and quoted from at page 19 of petitioner's brief, is on all fours with *Adams* v. *Burke, supra*, and need not be discussed separately. The defendant had purchased the patented articles, *free from restrictions*, from a territorial assignee who *had the right to make such a sale*. Therefore, those articles had passed outside of the patent monopoly.

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[1] *Supra*, page 40.

3. *"Attempted Restrictions on Resale Prices and Use":*

Under this heading, petitioner[1] groups the decisions of this Court in *Bauer* v. *O'Donnell*, 229 U. S. 1;[2] *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490;[3] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8,[4] and *Motion Picture Patents* v. *Universal Film Mfg. Co.*, 243 U. S. 502.[5]

Petitioner correctly says of the first three of these decisions that they "were concerned with the efficacy of attempted *resale price* restrictions". It is because they were concerned only with attempted restrictions of that particular character, that they are not pertinent here. As we have seen,[6] the Court held in those cases that resale price restrictions were void as beyond the protection and purpose of the patent act and as against public policy. Where such a restriction, which is void *per se*, is the only one attempted to be attached to the sale of a patented article, the result is the same as if the sale had been unrestricted. An unlimited license is implied and the article passes outside of the patent monopoly. But this is not so where the restriction itself is a proper exercise of the patentee's exclusive rights, as is the restriction upon the use of the patented machine itself, with which we are concerned in this case. In none of the resale price cases did the Court have occasion to consider restrictions of this character and it did not do so.

At page 20 of its brief, petitioner quotes from the decision in the *Boston Store* case, 246 U. S. 8, 23, a portion of this Court's comment on the *Bauer* v. *O'Donnell* decision.

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[1] Brief, page 19.

[2] *Supra*, pages 32, 33.

[3] *Supra*, pages 20, 33.

[4] *Supra*, page 33.

[5] The old Circuit Court case of *Washing Mach. Co.* v. *Earle*, 29 Fed. Cas. 332 (Case No. 17,219), referred to by petitioner on pages 12 and 38 of its brief, is merely one of a number of similar cases, decided *before* this Court's decision in *Mitchell* v. *Hawley*, and involved an *unrestricted* sale by a licensee.

[6] *Supra*, pages 32, 33.

In this quotation, petitioner omits the statement of the Court (p. 23, bottom):

> "As the case dealt with the right to vend under the patent law, the Court reserved any express statement concerning the scope of the right to use conferred by that law."

That statement would seem completely to dispose of *Bauer* v. *O'Donnell* as a precedent for the instant case.

Concerning the *Motion Picture Patents* case, petitioner says (p. 19) that it was concerned "with attempted limitations on *use*" (italics petitioner's). That is true only in a very broad sense, for as we have seen, the restrictions there involved related *not* to "the use of the [patented] machine itself", but to "the use of the supplies only", and specifically to the use of films which were not covered by the machine patent in suit but by a separate, *expired* patent. And it was upon the basis of that distinction, that the Court held those restrictions unenforceable under the patent law.[1]

In reference to the *Motion Picture Patents* decision, this Court did say, in its *Boston Store* decision, 246 U. S. 8, 25, as quoted by petitioner (p. 21):

> "Reiterating the ruling in the two last cases [referring to *Bauer* v. *O'Donnell* and *Straus* v. *Victor Talk-*

[1] Petitioner's partial quotation from the *Motion Picture Patents* case at the top of page 29 of its brief might perhaps be misleading. Petitioner there states that in that decision the Court held "that its previous decision in *Bauer* v. *O'Donnell* had interpreted the exercise of the right to vend, as freeing the article 'of every restriction which the vendor may attempt to put upon it' (*Motion Picture Patents* case, 243 U. S. 502, 516"). Petitioner should have started its quotation earlier, for what the Court actually said was that in *Bauer* v. *O'Donnell*, it had declared that (p. 516):

> "the right to vend is exhausted by a single, *unconditional* sale, the article sold being thereby carried outside the monopoly of the patent law and rendered free of every restriction which the vendor may attempt to put upon it." (Emphasis ours.)

> *ing Machine Co.*] it was again decided that, as by virtue of the patent law, one who had sold a patented machine and received the price, and had thus placed the machine so sold beyond the confines of the patent law, could not, by qualifying restrictions as to use, keep under the patent monopoly a subject to which the monopoly no longer applied."

The "subject to which the monopoly no longer applied", mentioned in the last two lines of this statement, clearly has reference to the films (supplies), the patent upon which had expired, but which the plaintiff was attempting to monopolize under the unexpired patent upon the machine. The statement that the Court had held in the *Motion Picture Patents* decision that one who had sold a patented machine "had thus placed the machine so sold beyond the confines of the patent law", is, we believe, inaccurate. If, at the time of that decision, the Court had been of *that* view, it certainly would not have gone to such pains in that decision to explain that (p. 512)[1]—

> "The difference is clear and vital between the exclusive right to use the machine which the law gives the inventor and the right to use it exclusively with prescribed materials to which such a license notice as we have here seeks to restrict it",

and it would not have held the restrictions there involved (p. 518)—

> "invalid *because* such a film is obviously not any part of the invention of the patent in suit."

And, of course, the *Boston Store* case did not require any ruling upon the validity of restrictions upon the *use* of the patented machine, for it was concerned only with restrictions attempting to fix resale prices.

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[1] *Supra*, page 35.

The last of the cases cited by petitioner in support of its position,[1] is *United States* v. *General Electric Company, et al.*, 272 U. S. 476, 489, where this Court again repeated the broad statement of the earlier cases. This case did not involve any question relating to the validity of restrictions imposed at the time of the sale. The restriction there in controversy was one contained in a license granted by a patentee to a manufacturing licensee fixing the price at which the latter could sell patented articles made by it under the license. The Court held that restriction *valid*, specifically reaffirming the doctrine of *Bement* v. *National Harrow Co.*, 186 U. S. 70.[2]

With regard to each of the decisions of this Court, from which petitioner quotes broad language in attempted support of its position, we might say, as this Court did of a case cited by one of the litigants in *Plumley* v. *Massachusetts*, 155 U. S. 461, 474:

> "It is sufficient to say * * * that it did not in form or in substance present the particular question now under consideration."

Similarly, in *Tyson* v. *Banton*, 273 U. S. 418, 433, this Court said:

> "There is some general language in the [cited] opinion which, superficially, might seem broad enough to cover cases like the present one. It was said, for example (p. 126): 'Property does become clothed with a public interest when used in a manner to make it of public consequence, and affect the community at large.' Literally, that would include all the large industries and some small ones; but *in accordance with the well settled rule the words must be limited to the case under consideration.*"[3]

The broad language which petitioner quotes from this Court's decisions is substantially the same as that used

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[1] Brief, page 33.

[2] *Supra*, page 25.

[3] Other cases to the same effect include *Cohens* v. *Virginia*, 5 U. S. 82, 97, 98; *Weaver* v. *Palmer Bros. Co.*, 270 U. S. 402, 414; *Home Bldg. & Loan Ass'n* v. *Blaisdell*, 290 U. S. 398, 434.

by *Robinson on Patents*, Sec. 824,[1] in stating that the usual sale of a patented article "delivers it from all the restrictions of the patent".

But Robinson adds, as this Court did, in effect, in *Mitchell* v. *Hawley*,[2] and as it might well have done in the decisions cited by petitioner had it been considering conditional or restricted sales, as well as unconditional ones:

> "To have that effect, however, the sale must be a lawful and *unconditional* sale."

And he then proceeds to point out that—

> "any person having the right to sell may at the time of sale restrict the use of his vendee within specific boundaries of time or place or method, and these will then become the measure of the implied license arising from the sale."

That, we believe, is the true rule.

This Court has never held otherwise with respect to restrictions *upon the use of the patented device itself*. And it has held restrictions, limiting the *time* of their use, valid and enforceable. *Mitchell* v. *Hawley*, 16 Wall. 544.[3] We believe that on the same reasoning, and under the same general rule, reasonable restrictions on the *field* of use, such as that in the case at bar, should be upheld.

Other Authorities Cited by Petitioner:

On page 30, petitioner quotes all of the following quotation from the 1937 Edition of Williston on Contracts, Volume 5, paragraph 1641, pages 4630-31, *except* the next to the last sentence which we have put in italics:

> "* * * It seems, indeed, to have been *suggested* by the Supreme Court of the United States, that as to patented articles there is an inherent inconsistency in selling property and imposing a restriction on the

[1] *Supra*, page 26.

[2] *Supra*, pages 16-19, 38.

[3] *Supra*, pages 16-19, 38.

buyer.[14] [1] This can only mean, however, that the patent laws give no protection to restrictive promises exacted from a buyer and that they must stand or fall under the common law as if the article was unpatented. *Probably this depends on whether such a contract or condition is part of a scheme to obtain a monopoly wider than that of the patented article.*[15] Certainly this result cannot be achieved by mere notices on patented articles.[16] ''

In note 15 Williston cites *Carbice Corp.* v. *American Corp.*, 283 U. S. 27. And, in note 16, he cites, in addition to the *Carbice* case, *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490, and the *Motion Picture Patents* case, 243 U. S. 502.

As Williston says in note 15, the *Carbice* case holds that a patentee cannot lawfully exact as a condition of a license that *unpatented* materials used in connection with the invention shall be purchased exclusively from him, and that, therefore, one supplying such *unpatented* accessories to the licensee to be used in disregard of the condition is not liable as a contributory infringer. Thus, it clearly appears from the complete quotation from Williston that he is of the opinion that there is nothing inconsistent in "selling property and imposing a restriction on the buyer", and he believes that restrictions which are within the patent monopoly and not "part of a scheme to obtain a monopoly *wider* than that of the patented article" as in the *Motion Picture* and *Carbice* cases, are valid and enforceable.[2] It is perhaps unnecessary to state that petitioner's partial quotation from this authoritative work is misleading in the extreme. In the same chapter

[1] Note that Williston does not say that this Court has held this, but only that it has "suggested" it; also, that Williston cites in his note 14 *Boston Stores* v. *American Graphophone Co.*, 246 U. S. 8, which, as we have seen (*supra*, pp. 45-46) involved a resale price restriction.

[2] On page 11 of its brief, petitioner is at great pains to create the impression that the patented amplifier here involved is "a standard article of commerce" such as was the solid carbon dioxide sought to be restricted in the

of Williston's work (paragraph 1642 which precedes the paragraph from which petitioner quotes) Williston deals generally with restrictions accompanying the sale of property. He says on page 4603:

> "* * * Similarly, a buyer may make a reasonable contract restricting himself from using the property which he has bought in a way which would compete with the seller, or be obnoxious to him."

and cites numerous cases in support thereof. And again, on pages 4604 and 4605, Williston states:

> "The only limits imposed by the law on the owner of property restricting his power to exact contracts from a subsequent purchaser to refrain from using the property in a certain way are those imposed by public policy, and though public policy forbids unreasonable restraint of trade, and therefore forbids a system of contracts attempting to control prices on resale, *there seems no reason why it should prohibit contracts which reasonably protect a business of either buyer or seller without tending to affect the public injuriously by monopoly or enhancement of prices.*"[1]

Carbice case. The solid carbon dioxide was, of course, not patented and was well known. All that petitioner is really saying is that the patented amplifiers here involved have been extensively used, as it has elsewhere admitted.

[1] On page 14 of its brief, petitioner makes the suggestion that the decision below would, for example, enable a patentee to prevent the owner of a patented pocket lighter from using it for lighting cigars while permitting its use for lighting cigarettes. As to this, it is perhaps enough to say that the use is the same and, what is more, the restriction would be wholly unreasonable and capricious. As Williston makes clear, even at common law where no statutory monopoly is involved, it is only reasonable restrictions which will be enforced, such as those in the present case, "which reasonably protect a business of either buyer or seller without tending to affect the public injuriously or enhancement of prices". See also *Fred Waring* v. *WDAS Broadcasting Station, Inc.* (Pennsylvania Supreme Court) 35 U. S. P. Q. 272, *infra*, page 61.

Also, on page 30 of its brief, petitioner quotes two short sentences from page 1002 of Professor Chafee's scholarly article of nearly one hundred pages on Equitable Servitudes on Chattels in 41 Harvard Law Review 945. We commend this article to the Court, and suggest that it establishes a very strong case for the enforcement of reasonable restrictions, such as that involved in the present case, on the use of chattels.

Again on page 30 of its brief, petitioner quotes the following sentence from Section 347 of Walker on Patents, 6th Edition:

> "But the purchaser of a patented apparatus, from the owner of the patent thereon, acquires whatever right that patent covers, to use that apparatus in accordance therewith, even where it is capable of a different use,[22] and by such sale the apparatus is thereby rendered free of every restriction which the patentee may attempt to put upon it.[22a]"

Walker cites in note 22 only the case of *Edison Electric Light Co.* v. *Peninsular Co.*, 101 Fed. 831 (C. C. A. 6), in which, as clearly appears from the opinion, the sale of the apparatus was *without reservation of any kind.* Petitioner omits any reference to this case in the quotation in its brief. In note 22a, Walker cites, as petitioner indicates, *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490 and the *Motion Picture Patents* case, 243 U. S. 502, which, as we have seen, involved, respectively, restrictions on the resale price of the article sold and on unpatented supplies. Petitioner omits to quote the following sentence which appears earlier in the same paragraph in Walker:

> "Nor does a sale, coupled with an express license to use, give any right to use after the license has been forfeited or has expired.[17] The purchaser of a patented thing gets no other right to use it than such right as the seller had an express or an implied right to convey.[18]"

In note 17 Walker cites the case of *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536, to which we have

previously referred[1] and in which the use of certain patented machines, which had been sold conditioned upon payment of royalty up to a certain date, was thereafter enjoined, since no agreement concerning royalties had been made after the expiration of the stipulated period. And in note 18, Walker cites *International Pavement Co.* v. *Richardson*, 75 Fed. 590, 594, in which the defendant was enjoined from using or disposing of certain patented machines the title to which he had acquired by sale from a licensee, the defendant having failed to pay the reserved royalty to the patentee.

There is nothing inconsistent between the sale of of a patented device and the simultaneous grant of a restricted license limiting its use to a particular field:

It is, of course, clearly established that the ownership of a *patented* device is entirely distinct from the right under the patent to sell or to use that device, and does not, *per se*, imply any such right. We have already referred to the statement of this Court in *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490, that the holder of a license to make and use the patented devices but not to sell them, *owns* the devices made under that license and may use them, but that—

> "• • • if he *sells* them, he infringes the right of the patentee, and may be held for damages and enjoined" (*supra*, p. 13).

Concerning the right of use, Judge Nixon said in *Wortendyke* v. *White*, 2 B. & A. 25, 28:

> "Confusion on this subject, has, doubtless, arisen from not distinguishing between the ownership of a patented machine and the right to use it. The one does not always include the other."

An ordinary infringer has title to the machine which he has made or acquired, but he may be enjoined from using it.

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[1] *Supra*, page 31.

Similarly in *Belknap* v. *Schild*, 161 U. S. 10, it was stated (p. 24):

> "Title in the thing manufactured does not give the right to use the patented invention. • • •"

To illustrate the application of this principle, we shall take the case of a patentee who has a patent for an amplifier, and who is engaged in the business of supplying amplifiers of his patent to theatres for use in talking picture equipment. Under the patent laws this patentee has the right "to exclude everyone from making, using or vending the thing patented, without • • • [his] permission". *Bloomer* v. *McQuewan*, 14 How. 539, 549.[1] He is unwilling to permit anyone to use the patented invention in the theatre field upon any terms. However, for a reasonable consideration, he is willing to permit the patented amplifiers to be used in homes, where they will not interfere with his theatre supply business.

There are several ways in which this patentee can permit another to use one of the patented amplifiers in his home, and still retain the right under the patent to enjoin as an infringement the use of that amplifier in a theatre.

One way is for him to license the prospective user for a lump sum, to make one of the patented amplifiers and to use it in his home only. The licensee will own the amplifier which he makes under this license. But, as pointed out above, the ownership does not carry with it any right to use the patented thing. The right to use it comes solely from the license to use, and is restricted to the terms of that license. Therefore, if the owner uses the patented amplifier outside of the terms of that license (for example, in a theatre) he is liable as an infringer. We think that there can be no dissent from this proposition.

Another way in which the patentee can accomplish the same result is to license the prospective user, again for a lump sum, to have one of the patented amplifiers made

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[1] *Supra*, page 12.

for him by some third person, and to use that amplifier in his home only. The same principle would apply, as before, and again the patentee's right to hold the licensee liable as an infringer, if he exceeded the restrictions of his license to use, could not be questioned.

But suppose that the licensee, instead of making the amplifier which he is to use under his license, or having some third party make it for him, desires to purchase it from the patentee himself, and that the patentee is willing to sell it to him. There would appear to be no reason why the patentee, for a lump sum, could not grant the licensee a restricted license to use one of the patented amplifiers only in his home, and at the same time convey to him the amplifier to be used under that license, without sacrificing his right to enforce the restrictions of the license. Surely, the carefully restricted express license which the patentee granted and the licensee accepted, should not be denuded of its restrictions merely because title to the vehicle for the enjoyment of that license happened to pass from the patentee to the licensee, instead of from some third person to the licensee, with the patentee's permission.

It is true that in such a transaction, the patentee would have received full consideration for everything that he had sold, that is, full consideration for the restricted license that he granted and, we will assume, a reasonable manufacturing profit upon the amplifier itself. But he would not have sold a license to use the amplifier in a theatre, *and he would not have received any consideration for such a license.* As was said in *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536, 537,[1]

> "the mere value of a patented machine is often * * * insignificant in comparison with the value of its use."

Furnishing the patented amplifiers to theatres was this patentee's livelihood and he was unwilling to grant

[1] *Supra*, page 31.

to anyone for any consideration any right under his patent, which would interfere with that business. If he had been willing to fix any terms upon which he would permit others to use the patented amplifiers in that field, undoubtedly those terms would have involved a very much greater payment than the one he accepted for the license for home use only. Clearly the receipt by the patentee of the consideration he asked for permitting a *specified restricted use* of his patented device should not be interpreted as consideration for permitting any and every use of it.

The transaction which we have just described as comprising the grant of a restricted license to use a patented device only in a specified field, and the simultaneous sale to the licensee of a device to be used under the license, differs in form only, from the transaction which petitioner says gives the purchaser an unrestricted license, namely, the sale by a patentee of one of his patented devices with notice brought home to the purchaser that he is licensed to use it only in a specified field. In the latter case, as in the former, there would appear to be no sound reason why the restricted character of the license granted should be affected in any way by the circumstance that the grant is accompanied by the sale of the patented device.

Ownership of a patented device is not inconsistent with the possession by the owner of only a restricted right to use that device. The mere fact that the ownership was acquired from the patentee, should not make it so. And, as we have seen, the authorities hold that it does not.

If the restrictions are not in themselves void as against public policy—and reasonable restrictions upon the field of use of the patented machine itself clearly are not because they are *within* the monopoly granted to the patentee—they are enforceable under the patent law against a purchaser with notice of them.

The restrictions involved in the present case are not contrary to public policy:

The argument of public policy, upon which are based the decisions of this Court regarding attempts to fix resale prices or to extend the scope of a patent monopoly beyond the statutory grant by compelling the purchaser of the machine to buy his supplies from the patentee, has no application whatever to restrictions of the sort here involved.

Obviously there is no public policy which requires the owner of a patent to allow others to use the patented invention itself against his will in any field.

> "If he [a patentee] sees fit, he may reserve to himself the exclusive use of his invention or discovery. If he will neither use his device nor permit others to use it, he has but suppressed his own. * * * his title is exclusive, and so clearly within the constitutional provisions in respect of private property that he is neither bound to use his discovery himself nor permit others to use it." *Paper Bag Patent Case*, 210 U. S. 405, 425, quoting from *Bement* v. *National Harrow Co.*, 186 U. S. 70, 90.

Particularly is there no public policy which prevents a patentee from restricting the use of the patented devices sold by him to specified fields, so as to preserve his right to the exclusive enjoyment of his invention in the field which he is himself cultivating—in this case the field of commercial talking motion pictures. We have already pointed out that public policy should favor the enforceability of such restrictions.[1]

The circumstances surrounding the granting of the license in this case to American Transformer Company, under the patents here in suit (and others), are illustrative of this point.

As is true of many inventions, the inventions of the patents in suit are useful for many purposes and in a number of fields. We have previously referred to the extensive

[1] *Supra*, page 23.

development work done by the Telephone Company and the Western Electric Company beginning in 1912 when the electronic tube became available to them. This work was carried on at great expense as was also the similar intensive development work of the General Electric Company and its associated companies. As usually occurs in the early development of any new art, conflicting rights arose which made it impossible as a practical matter to develop the new art commercially without infringing valid patents adversely held. Therefore, in order to make fully available to the public the great benefits of the new art it was necessary for the companies, which had made the major contributions to the art, to enter into a license arrangement permitting each to use in its own business field or fields the inventions of the others. Consequently, the cross license agreement[1] between the Telephone Company and the General Electric Company was entered into in July, 1920, and certain rights thereunder were extended,[2] to the Western Electric Company, and the Radio Corporation of America, the latter company having been formed in the meantime to engage primarily in the business of radio communication for tolls.[3]

As appears from these agreements, each party granted rights under its patents to the others in certain specified fields only, the restrictions being necessary to protect the business of each licensor in its own particular business fields.

For example, Schairer, Vice President of the Radio Corporation, testified that[4] his company was unwilling to grant licenses or to sell apparatus for use in the business of radio communication for tolls which was a new business and the principal business for which the Radio Corporation was formed.

The only practical way to make the apparatus available to the public for amateur and experimental purposes, such for example as broadcast reception, was to sell it with restrictions on its use at a relatively low price, the

[1] III, 1328.
[2] III, 1356.
[3] I, 515.
[4] I, 515 to 517.

return from which was in no way commensurate with the benefit which the purchaser would receive if he were permitted to use the apparatus for commercial purposes, such as wire or wireless telephony for tolls, talking motion pictures in theatres for profit, etc.[1]

Because of this situation, it was provided in the agreement of July, 1920 between the Telephone Company and the General Electric Company,[2] as follows:

> "4. Each party agrees that, so far as it is enabled so to do, it will in disposing of devices embodying inventions pertaining or applicable to vacuum tubes, or to generating, modifying, amplifying, transmitting or receiving electro-magnetic waves, or other devices or material the unrestricted sale of which would deprive the other party of rights to which it is entitled hereunder, use such precautions by contracts, restricted licenses or otherwise as may be necessary or advisable in order to prevent its customers or others from acquiring (by acquisition of devices from it or otherwise) licenses to use the same which the party disposing thereof has no right to grant."

This provision was also included in the modification of the same agreement entered into in July, 1926,[3] and in the later substitute agreement of July 1, 1932[4] which was approved by the Government in the settlement of the Government suits (*United States of Am.* v. *Radio Corp. of Am. et al.*). The stipulation approved by the Government states:[5]

> "The petitioner, by its Department of Justice, has examined all of the Agreements attached hereto, and also the above-mentioned Substitute License Agreement (B2) and Agreements Relating Thereto, and finds no objection to them."

This Agreement (B2), thus approved by the Government, contains a number of provisions granting licenses

[1] I, 516.
[2] III, 1347, Article VI, Par. 4.
[3] III, 1404, Article VI, Sec. 4.
[4] II, 784, Article VII, Sec. 4.
[5] II, 796.

restricted to various fields of use,[1] as has been stipulated is "common practice where a patented invention is applicable to different uses."[2]

The restricted licenses, contained in the contracts to which we have referred above, made possible the commercial development of radio broadcasting and broadcast reception in the home, etc. The Radio Corporation entered that field about 1919 and, since that time, has granted many licenses for the manufacture and sale by others of broadcast receivers, employing the inventions of the patents in suit. It was in keeping with its policy of developing and improving radio broadcast receivers, that the Radio Corporation, with the consent of the Telephone Company, in 1927 granted about thirty licenses[3] to different manufacturers, limited to the right to make amplifiers embodying these patents and to sell them "only for radio amateur reception, radio experimental reception, and radio broadcast reception".[4] One of these was the license granted to American Transformer Company, the vendor of petitioner's amplifiers (*id.*).[5]

If petitioner's argument is sound, then such limited licenses, restricted as to fields of use, can no longer be safely made; and a patentee having an important invention useful in many fields but having vital interests to protect in one field, can no longer sell or allow others to

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[1] II, 743.

[2] Stipulation, I, 585, *supra*, page 9.

[3] I, 333-335. [4] III, 1415.

[5] Petitioner refers on page 14 of its brief to the cases of *Stanley Co., General Talking Pictures Corp.*, and *Duovac Radio Corp.* v. *Am. Tel. & Tel. Co. et al.*, 4 F. Supp. 80, on motion for preliminary injunction; and 18 F. Supp. 650, at final hearing. The preliminary injunction was never issued, and at final hearing a permanent injunction was refused. The only appeal which was filed by the plaintiffs was that of the petitioner here, General Talking Pictures Corp. Although its appeal was filed on July 13, 1937, it has never been perfected by printing or filing the record.

sell the patented devices for use in other fields, for, as soon as he does so, he exposes his own vital field to competition by others in the use of his own invention. The public, as well as the patentee, would suffer great damage by any such ruling.

Assume the case where a patented machine is sold by the patentee to a college laboratory with a condition that it should be used only for experimental purposes. Surely, it cannot be successfully contended that such a sale, made upon the express condition that the patented machine was not to be used commercially, gives the purchaser by law the unrestricted right to use the machine commercially in defiance of the restriction. If that were the law no such sale could be made at any reasonable price. Yet that, in substance, is what petitioner is contending in this case.

In short, to sustain the proposition for which petitioner contends, and to hold that a patentee cannot convey with the sale of his patented device, an effectively restricted license limiting the purchaser's right to use that device to specified fields, would be to subvert principles of patent law which have been universally accepted as true from the very beginning of our patent system, which have been sanctioned by many court decisions, and upon which, as a basis, innumerable patent licenses have been and are every day being granted.

There is no public policy, and no principle of law which compels or warrants any such ruling as that now asked by petitioner; and there is no decided case which, properly read, supports any such ruling.

The recent decision by the Pennsylvania Supreme Court in *Fred Waring* v. *WDAS Broadcasting Station, Inc.*, 35 U. S. Patent Quarterly 272:

This case, which was decided October 8, 1937, is of interest both because of its facts and the court's decision on those facts, and also because of the court's comments upon certain of the decisions of this Court which are relied upon by petitioner in the instant case.

In the cited case, Fred Waring's popular orchestra, the "Pennsylvanians", commanded sizable fees for its rendition over the radio of dance music and the like. It also made phonograph records of its rendition of such selections. These were sold to the public, marked "Not licensed for radio broadcasts". The defendant purchased one of these records. It had a license from the copyright owner to perform for profit the copyrighted selection in question. It did so by broadcasting the record of Waring's rendition of that selection. Waring brought suit to enjoin defendant's doing this. The injunction was granted by the lower court and its decision was affirmed by the Supreme Court of Pennsylvania. The ground adopted by the latter court was that Waring had a property right in his rendition of the selection in question, which was distinct from the rights of the owner of the copyright in the selection itself, and that in broadcasting that rendition from the record, the defendant was competing unfairly with Waring who was in the business of broadcasting that rendition for profit. It held that the "equitable servitude", in the form of restrictions which the license notice placed upon the use to which the record could be put after its sale, was proper and equitable under the circumstances and that the restrictions were enforceable at common law. The following comment of the court is of particular interest here (pp. 277, 278):

> "• • • The most common type of case in which such restrictions have been held unenforceable is where an attempt was made by a manufacturer or the owner of a patent, trade mark or copyright to fix a minimum resale price: Taddy & Co. *v.* Sterious & Co., 1 Ch. (1904) 354; McGruther *v.* Pitcher, 2 Ch. (1904) 306; Bobbs-Merrill Co. *v.* Straus, 210 U. S. 339; Park & Sons Co. *v.* Hartman, 153 Fed. 24; Dr. Miles Medical Co. *v.* Park & Sons Co., 220 U. S. 373; Bauer *v.* O'Donnell, 229 U. S. 1; Straus *v.* Victor Talking Machine Co., 243 U. S. 490; Boston Store of Chicago *v.* American Graphophone Co., 246 U. S. 8; Garst *v.* Hall & Lyon Co., 179 Mass. 588; Garst *v.* Wissler, 21 Pa. Superior Ct. 532, or where there was

a provision that the article sold should be used only in connection with other property manufactured by the vendor: Motion Picture Patents Company *v.* Universal Film Manufacturing Co., 243 U. S. 502; Carbice Corporation of America *v.* American Patents Company *v.* Universal Film, 283 U. S. 26. These cases depend essentially upon the fact that the attempted restrictions, being in restraint of trade, were against public policy, * * *.

"* * * It is true that in addition to the question of public policy other factors may weigh against the imposition of such restrictions in many, perhaps most, instances. Thus an attempted restriction, instead of being aimed at the accomplishment of a useful commercial, industrial or social purpose, may be merely capricious and serve only to clog the free and untrammeled circulation of personal property. Again, in the case of some restrictive covenants limiting the use of chattels, it might be difficult, if not impossible, to detect breaches so as to make legal enforcement practical. There is no reason, however, why an ancient generalization of law should be held invariably to apply to cases in which modern conditions of commerce and industry and the nature of new scientific inventions make restrictions highly desirable. *Mere aphorisms should not be permitted to fetter the law in furthering proper social and economic purposes.*"[1]

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[1] The Court's attention is also called to the case of *Waterson et al.* v. *Irving Trust Co.*, 48 F. (2d) 704, (C. C. A. 2), decided since the present case was brought, in which the court below held that certain music copyrights, after sale by a trustee in bankruptcy, were still subject to the composers' reserved rights to royalties. The authorities relating to equitable servitudes on chattels are extensively reviewed in the opinion by Judge A. N. Hand and numerous instances are cited of restrictions on the use of chattels which have been enforced by the courts. The opinion states (p. 708):

"Courts in the United States have enforced rights resembling an equitable servitude binding on a third party who has acquired personal property from one who is under a contract to use it for a particular purpose or in a particular way" (Citing numerous cases)."

So, in the instant case, the oft repeated saying that the sale of a patented article frees it from the patent monopoly, should not be permitted to destroy reasonable restrictions upon the field of use of such articles where, as in the case at bar, those restrictions are clearly within the monopoly of the patent law, are not in their nature illegal or unreasonable, but serve a proper and desirable economic purpose.

It should not be forgotten that we are here dealing with a statutory grant, the extent of which must be determined from the statute itself as has been made clear by this Court in many decisions, including the *Motion Picture* case, *supra*, and *Dr. Miles Medical Co.* v. *Park & Sons Co.*, 220 U. S. 373, 401-402. Thus, even if it were true at common law—and it is not as we have seen—that after sale no restriction of any nature on unpatented personal property would be enforced, that would not control this patent case. Assuming the restriction upon a patented device is not unreasonable, the sole and only question is whether the restriction is within the statutory grant of the exclusive right to use. In addition to its holding in *Mitchell* v. *Hawley* (that restrictions on *time* of use of a patented machine are valid) this Court has recently indicated, if it has not actually held, in the *Motion Picture* case, *supra*, that restrictions which are on the use of the patented device itself are within the monopoly granted by the statute. It would therefore seem clearly to follow that this question should be answered in the affirmative.

We submit that on principle and authority, reasonable restrictions upon the field of use of a patented device sold under the patent, are valid and enforceable under the patent law as against a purchaser with notice of the restrictions. Therefore, petitioner would be an infringer even if the sale of the patented amplifiers to it had been *under* the patents, instead of *in infringement* of the patents.

PART II.

Respondents are not estopped by acquiescence to hold petitioner liable as an infringer.

Petitioner's asserted defense of estoppel by acquiescence, to which this part of our brief is directed, does not involve any question or ground put forward in the petition as a reason for the granting of the writ. Therefore, as we have said, we doubt that this Court will wish to consider it at all, particularly in view of the concurring decisions of the lower courts overruling it.[1]

Petitioner's specification of error in this regard is that the Circuit Court of Appeals erred—

> "(4) In failing to hold that by the acceptance and retention, by plaintiffs-respondents' authorized agent, of the royalties paid by the licensed manufacturer of the alleged infringing devices, plaintiffs-respondents were barred, under the equitable principles of acquiescence and estoppel, from maintaining this suit."

This defense is wholly without factual basis. The pertinent facts established by the record and found by the courts below are (1) that these infringement suits were brought promptly (less than five months) after respondents first learned that petitioner had acquired and leased one of the amplifiers in question for use in a theatre; (2) that prior to the institution of these suits, neither respondents nor their licensing agent had received any royalties from the Transformer Company, with knowledge that they applied to amplifiers sold to petitioner; and (3) that all royalty payments made by the Transformer Company, whether before or after the filing of the suit, which were found to apply to amplifiers sold to petitioner, were refunded to the Transformer Company and accepted by it.

[1] *Supra*, page 7.

Concerning the respondents' promptness in bringing suit, the District Court found:[1]

"The defendant made its first purchases of these amplifiers in the month of February, 1929, nearly five months after its incorporation. Thereafter the defendant leased a complete talking motion picture equipment, which included one of these amplifiers, to a theatre in Allentown, Pennsylvania, where the equipment was installed during the month of April. On the 19th day of that month, the plaintiffs' investigators examined the equipment in order to ascertain the precise facts with reference to the operation of the various circuits and whether the plaintiffs' patents were involved. This was a substantial task and a report, based upon the studies, was not completed until some time during the month of July, 1929, and by the end of August the executive officers authorized the institution of this suit; these several bills were filed September 13th [1929].

"* * * There is no plea of laches made for the defendant and consequently there is no necessity for making a finding on the subject. If there were, it would be in the negative."

Concerning royalties, the District Court found:[2]

"There is nothing in the evidence which tends to show that the plaintiffs [respondents], or their licensing agent, the Radio Corporation, prior to the filing of these suits, received royalties from the American Transformer Company, with knowledge that they were paid on account of sales of amplifiers to the defendant, which had been made contrary to the terms of the license, and for use of the devices in violation of the notice attached to them."

"The evidence shows that during the month of December, 1929, three months after these suits were filed, the American Transformer Company, pursuant to request, began to furnish to the Radio Corporation lists of its customers (including this defendant) to whom amplifiers had been sold, and that, one year

[1] III, 1638. [2] III, 1646.

later, the royalty payments which applied to the defendant's purchases were returned to and accepted by the licensee.'"[1]

Accordingly, the District Court dismissed this defense. The Circuit Court of Appeals, after referring to the fact that no royalties upon petitioner's amplifiers were knowingly received by respondents or their agent before the filing of these suits, said:[2]

"• • • it is difficult to see how later royalties can act as either acquiescence or estoppel since the very maintenance of the suit showed defendant that there was no acquiescence on which it could rely."

Then, after referring to the return of these later royalties to the Transformer Company and the latter's acceptance of them, and to the fact that respondents had filed these suits within five months after learning of the infringement, that court concluded (*id.*), as the District Court had done:

"This defense is without merit."

Argument.

The rule applicable to defenses of this character, is well stated in *Miller* v. *Hayman*, 46 F. (2d) 188, 197, where it is said:

"• • • as estoppels preclude a party from showing the truth, they are not favored and should not be applied to any case where the facts do not clearly justify their application."

That the facts in this case do not support any such defense, is obvious from the facts themselves, as found by both of the courts below.

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[1] III, 1645. [2] III, 1725.

For the law upon the question of what facts are necessary to justify the application of the doctrine of estoppel, we need go no further than the decision of this Court in *Brant* v. *Virginia Coal & Iron Co., et al.*, 93 U. S. 326, from which petitioner also quotes a passage. In that decision it was said (pp. 335, 336):

> "It is difficult to see where the doctrine of equitable estoppel comes in here. For the application of that doctrine there must generally be some intended deception in the conduct or declarations of the party to be estopped, or such gross negligence on his part as to amount to constructive fraud, by which another has been misled to his injury. 'In all this class of cases,' says Story, 'the doctrine proceeds upon the ground of constructive fraud or of gross negligence, which in effect implies fraud. And, therefore, when the circumstances of the case repel any such inference, although there may be some degree of negligence, yet courts of equity will not grant relief. It has been accordingly laid down by a very learned judge that the cases on this subject go to this result only, that there must be positive fraud or concealment, or negligence so gross as to amount to constructive fraud.' 1 Story's Eq. 391. To the same purport is the language of the adjudged cases. Thus it is said by the Supreme Court of Pennsylvania, that 'the primary ground of the doctrine is, that it would be a fraud in a party to assert what his previous conduct had denied, when on the faith of that denial others have acted. The element of fraud is essential either in the intention of the party estopped, or in the effect of the evidence which he attempts to set up.' "

It is not even claimed by petitioner that it has made out a case of estoppel under this definition.

The excerpt which petitioner quotes from this same opinion states that even in the absence of fraud, actual or constructive, "where one has received the fruits of a transaction he is not permitted to deny its validity *whilst retaining its benefits*". Clearly that has no application here, for respondents *did not retain* any benefits of any transactions between the Transformer Company and petitioner. They did not knowingly even *receive* any

"royalties" upon those transactions prior to the filing of the present suits, and they returned *all* royalties which they ever received upon those transactions when they learned that they were such. It is a mere play upon words for petitioner to contend as it does that respondents' associate "retained" these royalties, within the meaning of the decision cited, when in fact they retained them only until they returned them to the Transformer Company.

Petitioner seeks to give the impression also, that neither the respondents nor the Radio Corporation ever objected to the Transformer Company's sale of the amplifiers in question to petitioner for theatre use. That is absolutely contrary to the fact.

In September, 1927, the Transformer Company wrote to the Radio Corporation asking whether its license might not be extended to permit it to sell patented amplifiers for this use.[1] The Radio Corporation replied in the negative.[2]

In the late summer of 1929, the Transformer Company was notified by the Radio Corporation that it was selling apparatus outside of the scope of its license.[3] In September, 1929, these suits were brought against petitioner. And in December, 1930, the Transformer Company was notified in writing that:[4]

> "The sale of apparatus for unlicensed uses is an infringement of the patents covering the apparatus. We must protest and insist upon immediate discontinuance of such sales for uses such as for public address systems or in connection with talking motion pictures.
>
> "We also take this occasion to notify you that we reserve the right to take appropriate action against your company and/or your customers for infringement arising out of unlicensed manufacture, use and/or sale."

Under the circumstances of this case, where the only royalties ever received by respondents with knowledge

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[1] II, 1213.
[2] II, 1214.
[3] I, 610, 611.
[4] II, 1217.

that they applied to the infringing amplifiers, were paid by the Transformer Company after that company had been notified of its infringement and after these infringement suits against petitioner had been brought, respondents might have retained those royalties without affecting their right to continue the prosecution of these suits. See *Vulcan Mfg. Co.* v. *Maytag Co.*, 73 F. (2d) 136 (C. C. A. 8), in which a similar defense was raised by a defendant-licensee who was sued for infringement for exceeding his license and where the royalties had *not* been returned. In that case, the court said (p. 141):

> "Another matter strongly pressed by appellant is that royalties were accepted and retained upon the changed machines. This is true, but it is also true that appellee had a legal right to such royalties; the question here being whether its acceptance and retention thereof was an indication that it consented to the violation of the license or was such action that appellant might properly infer such consent and act thereon. When it is considered that the matter was under investigation until April 2, 1928, was in suspension between then and the time suit was filed, on July 19th following, and that this suit was filed, it seems impossible for the appellant to reasonably infer any such consent. There is no basis for such position."[1]

A fortiori, where, as here, the royalties were not *retained* but were *returned,* the defense of acquiescence must fail.

Clearly, there is no justification in fact for petitioner's contention that "by their deliberate acts respondents must be deemed to have acquiesced in and to have ratified the acts complained of and to have waived any claim of infringement based thereon."[2] The facts establish just the opposite, as both of the lower courts held.

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[1] Petitioner points out (Brief pp. 10, 11) that one of the reasons relied upon in the petition for writ of certiorari, granted by this Court in the *Maytag* case and later dismissed on stipulation (294 U. S. 553 and 294 U. S. 734), was based upon the acceptance of royalties, but petitioner does not state that the other reason relied upon was restraint of trade under the Anti-Trust laws.

[2] Brief, page 43.

PART III.

The fact that the continuation applications, upon which two of the Arnold patents issued, were filed more than two years after the patentee's first public use of their inventions, does not invalidate those patents, because those inventions were disclosed in Arnold's earlier original applications.

Petitioner contends that four of the Arnold patents are invalid because they issued upon continuation or divisional applications filed more than two years after their owner, the Telephone Company, first used their inventions in its Transcontinental Telephone Line which was opened to the public in January, 1915.

At the outset it should be noted that petitioner's contention could not possibly apply to more than two of the Arnold patents, namely, the Power Circuit Patent (1,329,283) and the Definite Input Impedance Patent (1,448,550), because, as the record shows, and as both of the courts below found, there was no public use of the inventions of either of the other Arnold patents prior to the filing dates of the divisional applications upon which they issued.[1] Therefore, we shall confine our discussion of this point to the two Arnold patents above identified.

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[1] I, 95; III, 1721, 1679. Petitioner's mistaken assertion to the contrary (Brief, p. 44) is based solely upon the statement of Kendall (I, 102) that "I *think* that the subject matter of each of those patents" was used by the Telephone Company at least as early as September, 1915. The drawings of the Transcontinental Telephone Line were introduced by respondents and they do not contain the inventions of the two patents mentioned (Exhibits 8 and 9, II, 657, 658).

In the case of these two patents, the only public use asserted is the patentee's. And, occurring as it did in 1915, it did not precede by as much as two years, if at all, the filing of Arnold's original applications disclosing the inventions of those patents. There is no contention that the inventions of either of these Arnold patents was used by anyone adverse to the patentee prior to the filing of the continuation applications on which they issued, or that any patent claiming the inventions issued to anyone prior to that time. Further, petitioner itself did not use the inventions until 1929,[1] the year the present suits were filed,[2] and so can claim no intervening rights, as both lower courts held.[3]

The Power Circuit Patent issued on an application filed July 30, 1918. This application was a continuation of two earlier applications, both of which were filed *May 28, 1914*.[4] The Definite Input Impedance Patent issued on an application filed February 3, 1919.[5] This application was also a continuation of two earlier applications filed *September 3, 1915* and *November 2, 1915*.[6]

Petitioner admits[7] that the inventions claimed in the claims in suit of each of these Arnold patents[8] were fully disclosed in their respective original applications

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[1] III, 1681.

[2] Petitioner was not organized until September 12, 1928 (I, 392); it purchased the first infringing amplifier on February 4, 1929 (I, 392; II, 1225); and these suits were filed September 13, 1929.

[3] III, 1722; 1681.

[4] II, 628.

[5] II, 641.

[6] II, 641, lines 97-100.

[7] Brief, page 43.

[8] Claims 7, 10, 13 of the Power Circuit Patent; claims 1, 12 of the Definite Input Impedance Patent.

filed in 1914 and 1915.[1] We are, therefore, not concerned here with any of the technical distinctions between divisional applications and applications which are termed continuations or continuations-in-part.[2] The original and also the continuation applications were regularly prosecuted in the Patent Office within the time limits permitted by the statute.[3]

There was also continuity in the prosecution of the applications for each of the patents. One of the original applications on which the Power Circuit Patent is based was pending in the Patent Office on July 30, 1918 when the continuation application was filed,[4] thus maintaining the continuity of the prosecution. The other original application for this patent issued as patent

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[1] As to the Power Circuit Patent (1,329,283) see the specifications of the original applications (II, 1240-1244 and II, 1104-1111); as to the Definite Input Impedance Patent (1,448,550) see the specifications of the original applications (II, 997 and II, 1130).

[2] These distinctions are pointed out in *In re Klein*, 1930 C. D. 2; and see also *Ex parte Ellis*, 1919 C. D. 64. Divisional applications are merely a particular form or species of continuation applications.

[3] R. S. 4894; 35 U. S. C. 37: "All applications for patents shall be completed and prepared for examination within six months [formerly one year and two years] after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same within six months [formerly one year and two years] after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the Commissioner of Patents that such delay was unavoidable." And see *Overland Co.* v. *Packard Co.*, 274 U. S. 417, 422; *Chapman* v. *Wintroath*, 252 U. S. 126, 137; *United States* v. *American Bell Telephone Co.*, 167 U. S. 224, 247.

[4] II, 1304.

No. 1,129,942 on March 2, 1915[1] with claims for different subject-matter from that of the patent in suit. In compliance with Patent Office Rule 43,[2] this 1915 patent expressly refers to the other original application as "a copending application in my name" for the subject-matter for which the Power Circuit patent ultimately issued on the continuation application.[3] The reason for the Patent Office Rule, requiring such references to a pending application, is, of course, to prevent any inference that subject-matter disclosed but not claimed in the issued patent has been abandoned. So also, in the case of the Definite Input Impedance Patent there was continuity of prosecution between the original applications and the continuation application. Both original applications for this patent were pending in the Patent Office on February 3, 1919 when the continuation application was filed.[4]

Furthermore, as the court below found, while "the particular combinations of the claims in suit were not

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[1] III, 1455.

[2] "43. When an applicant files two or more applications relating to the same subject matter of invention, all showing but only one claiming the same thing, *the applications not claiming it must contain references to the application claiming it.*"

[3] Patent No. 1,129,942 states (III, 1456, lines 9 to 14): "The structures which will provide the greatest degree of efficiency [power] in the above mentioned different types of audions form the subject-matter of a copending application in my name, Ser. No. 841,567 filed of even date herewith."

Petitioner states (Brief, p. 45) that "Concededly, only the second of these two applications," *i. e.* the one on which patent No. 1,129,942 issued, "is pertinent to our inquiry". We do not know what is intended by this statement and we are unable to see that it has any significance.

[4] II, 1028; II, 1165.

specifically claimed" in the original applications, "broader combinations were claimed".[1]

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[1] III, 1722. Thus in the Power Circuit Patent, the particular combinations of the claims in suit include, as we shall see, the three elements of the vacuum tube and the limitation that they shall be so spaced that the impedance of the tube between its anode and cathode is of the same order as the outgoing circuit. These same elements and their spacing constituted the subject-matter of claim 4, for example, of original application 841,567 (II, 1245), but that claim did not contain any specific limitation, and was therefore generic, with respect to the amount of impedance between the anode and cathode. Similarly, the particular combinations of the claims in suit of the Definite Input Impedance Patent, include the three-element vacuum tube, and the input circuit for that tube. Also, as a limitation with respect to the input circuit the claims specify that that circuit has a conductive impedance shunted across it or like limitation. Claim 6, for example, of original application 59,210 (II, 1134) includes these same things but more broadly in that it omits the specific limitation with respect to the shunted impedance element of the input circuit.

On page 53 of petitioner's brief, petitioner refers to the above finding of the court below that broader combinations were claimed in the original applications and then makes the astonishing statement that "no assertion to that effect has ever been made by respondents in the Courts below, either in the record, the briefs, or in oral argument." In the District Court the petitioner made no assertion that the inventions were not claimed in the original applications. When the contention was made in petitioner's brief in the Court of Appeals, we specifically pointed out on page 45 of our brief in that court that while the particular combinations of the claims in suit were not specifically claimed in the original applications, broader combinations were claimed and, as appears above, the Court of Appeals so found. We also referred that court to the claims of the original applications.

Argument.

As appears from the foregoing statement of facts, the inventions of neither of these Arnold patents was in public use two years before their original applications were filed. The public use did not occur until nearly a year after the original applications of the Power Circuit Patent were filed, and less than a year before the filing of the original applications of the Definite Input Impedance Patent. And there was no adverse claimant or adverse user of the inventions prior to the issuance of the patents. Moreover, the original applications at the time they were filed contained claims for broader combinations than the claims in suit of the continuation patents.[1] Petitioner concedes[2] that this alleged defense is not made out if the inventions were claimed in the original applications. However, *since the public use relied upon was solely by the patentee,* we do not consider it at all material whether the inventions were or were not claimed in the original applications.

The General Rule Applicable to this Case:

The general rule is well established that where a second application, either divisional or continuation, is filed by an applicant during the pendency of an original application, that second application is entitled to the filing date of the original, *with regard to all subject-matter that is common to the two.*

In the instant case, petitioner concedes[3] that the subject-matter of the claims of the two patents now under discussion was disclosed in the original applications, and carried over from those applications into the continuation applications upon which these patents issued. Therefore,

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[1] *Supra,* pages 74-75.

[2] Brief, page 47.

[3] Brief, page 43.

the effective filing dates for those claims are the dates of the respective original applications. And since the public use here relied upon commenced less than two years prior to those dates, it was not a public use of the invention "for more than two years prior to his [Arnold's] application" within the meaning of the statute,[1] and therefore is not a defense against the Arnold claims.

Cases directly in point on this proposition are cited in the margin.[2] As stated by this Court in *Chapman* v. *Wintroath*, 252 U. S. 126, 137:

"• • • not only have later or divisional applications not been dealt with in a hostile spirit by the

[1] R. S. 4886; 35 U. S. C. 31. So far as material here this statute provides that an inventor whose invention has not been "in public use or on sale in this country for more than two years prior to his application" may "obtain a patent therefor".

[2] *Chapman* v. *Wintroath*, 252 U. S. 126, 137; *Smith & Griggs Mfg. Co.* v. *Sprague*, 123 U. S. 249, 250; *Smith* v. *Goodyear*, 93 U. S. 486, 501; *Godfrey* v. *Eames*, 1 Wall. 317, 324-326; *Wirebounds Patents Co.* v. *Saranac*, 37 F. (2d) 830, 841 (C. C. A. 6; Denison, *J.*); *American Laundry Mchy. Co.* v. *Prosperity Co.*, 295 Fed. 819 (C. C. A. 2), cited with approval by this Court in *Webster Co.* v. *Splitdorf*, 264 U. S. 463, 4[illegible]5; *American Chain Co.* v. *Franklin-New York Co.*, 34 F. (2d) 551 (E. D. N. Y., Campbell, *J.*); *American Chain Co.* v. *Stewart-Warner Speedometer Corp.*, decided by Thatcher, *J.*, December 26, 1928 and unreported. Also Walker on Patents (6th Ed.) states (p. 246) as to *continuing* applications: "When the two applications are continuous the two years' public use or sale which may avoid the patent must be reckoned from the presentation of the first application, and not from the filing date of the subsequent applications or amendments"; and as to *divisional* applications (p. 246): "where an application covers two inventions, one of which is withdrawn therefrom by division and made the subject of a divisional application, that new application relates back to the original application from which it was carved, and is not chargeable with any diminution of significance, on account of the transaction."

> courts, but, on the contrary, designed as they are to secure the patent to the first discoverer, they have been favored to the extent that *where an invention clearly disclosed in an application, as in this case, is not claimed therein but is subsequently claimed in another application, the original will be deemed a constructive reduction of the invention to practice and the later one will be given the filing date of the earlier, with all of its priority of right. Smith & Griggs Manufacturing Co.* v. *Sprague,* 123 U. S. 249, 250; *Von Recklinghausen* v. *Dempster,* 34 App. D. C. 474, 476, 477.'"[1]

In the above cited case of *Smith & Griggs Mfg. Co.* v. *Sprague,* 123 U. S. 249, this Court found that the invention of the divisional patent in suit had been in public use by the *patentee* more than two years before the filing of the *original* application and therefore held the patent invalid. But in passing upon this defense this Court also held that the divisional patent was entitled to the date of the original application, saying (p. 250):

> "The machines described in the two patents, it is admitted, are substantially the same in construction and operation, both patents being for different parts and combinations of a single machine. For the purposes of this case, therefore, the date of the application is to be taken as of December 2, 1878, being the earlier of the two."

So also in *Godfrey* v. *Eames,* 1 Wall. 317, which concerned a continuation application of the type here involved, the invention had been put in public use by the *patentee* more than two years before his continuation application was filed (though less than two years before his original

[1] This Court also decided in *Milburn Co.* v. *Davis Co.* 270 U. S. 390, 401, that what was disclosed in an application duly filed is a reduction to practice, and evidences a completed invention at the date of filing, even though it was *not* claimed.

application) and the same contention was made as here. Rejecting the contention, this Court held (pp. 325, 326):

> "In our judgment, if a party choose to withdraw his application for a patent, and pay the forfeit, intending at the time of such withdrawal to file a new petition, and he accordingly do so, the two petitions are to be considered as parts of the same transaction, and both as constituting one continuous application, within the meaning of the law."[1]

The Special Rule of the *Chapman* and *Webster* Cases:

The special rule of *Chapman* v. *Wintroath*, 252 U. S. 126, and *Webster Co.* v. *Splitdorf*, 264 U. S. 463, we understand to be, that a patent is invalid if the patentee without excuse delayed claiming the invention for more than two years after an adverse claimant or adverse user of the same invention appeared. The rule is merely a special application of the doctrine of equitable laches or estoppel[2] which prohibits the enforcements of claims where their enforcement would be inequitable. In every case with which we are familiar, applying this rule, the patentee had been stirred into filing the dominating claims by knowledge of his adversary's activity and had failed to act with the promptness required.

The principle of the *Chapman* and *Webster* cases obviously is just as applicable to original applications

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[1] This case of *Godfrey* v. *Eames* is of particular interest because it is also authority for our position that the special rule of this Court's decisions in the *Webster* and *Chapman* cases, *supra*, is not applicable even where the invention was not claimed in the original application. This was the situation in *Godfrey* v. *Eames*, as clearly appears from the record in the case.

[2] See for example *Galliher* v. *Cadwell*, 145 U. S. 368, 371-373.

as it is to divisional or continuation applications,[1] and, we believe, is wholly inapplicable to a case such as the present one in which the elements of equitable laches and estoppel are entirely lacking because there was no adverse claimant or adverse user of the invention. As stated by the District Court in its opinion in this case:[2]

> "The important aspect of the argument lies in the fact that it is not supported by any equitable considerations because the public use to which the defendant refers is the plaintiffs' own use, not that of any other inventor."

The facts of the *Chapman* case were these: Chapman filed in 1909 his original application which disclosed but did not claim the invention. An adverse claimant, Wintroath, filed an application for the same invention in 1912, and his patent claiming the invention issued November 25, 1913. On July 6, 1915, Chapman filed a divisional application copying the claims from Wintroath's patent. The case, therefore, involved a delay of twenty months on the part of Chapman in claiming for the first time in a divisional application the subject-matter of his adversary's patent. By analogy to the patent statutes[3] and the de-

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[1] See the able discussions of this point in the opinion by Judge Denison in *Wagenhorst* v. *Hydraulic Steel Co.*, 27 F. (2d) 27, 28-32, and in the opinion by Judge Hough in *American Laundry Mch'y Co.* v. *Prosperity Co.*, 295 Fed. 819, 822, 823. Also, as stated by the court in *Dwight & Lloyd* v. *Greenawalt*, 27 F. (2d) 823, 831 (C. C. A. 2):

> "It is now settled law, in spite of any doubts that may have been cast upon it by certain observations in *Chapman* v. *Wintroath*, 252 U. S. 126, 40 S. Ct. 234, 64 L. Ed. 491, that a divisional application is no more than an amendment in the parent application, * * * *Webster* v. *Splitdorf*, 264 U. S. 463 * * *."

[2] III, 1680, 1681.

[3] R. S. 4886, 4897 and 4920; 35 U. S. C. 31, 38, 69.

cisions in the reissue cases, this Court stated that an inventor whose application discloses but does not claim an invention which is later patented to another is allowed two years after such patent issues within which to file a second or divisional application claiming the invention.[1] Because Chapman had made his claims within two years after the adverse patent issued, it was held that Chapman was within his rights in so doing.

In the *Webster* case, Kane, the patentee of the patent in suit, filed in 1910 his original application disclosing but not claiming the invention. On March 4, 1913 an adverse patent issued to a rival inventor, Podlesak. In 1915 Kane filed a divisional application in which the invention was disclosed but was still unclaimed. On June 17, 1918, more than five years after the Podlesak patent had issued, Kane inserted in his divisional application the claims in suit which were new and broader claims than he had ever made before and which dominated the 1913 Podlesak patent. It further appears from the opinion (p. 465) that Kane *intentionally* refrained from making the claims "because he considered their subject-matter one merely of design and not of invention"[2] and that "During all this time" the invention was "in *general* use". In support of the latter statement, the record in the case shows that the *defendant* had put the invention in general use by the middle of 1915.[3]

Again, this Court commented upon the analogy to the patent statutes and the decisions in the reissue cases, and this time held that the patent in suit (Kane's) was invalid

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[1] As this Court made clear in the *Webster* case (264 U. S. 463, 471) this rule is merely one of assumed or imputed laches and not of statutory firmness.

[2] See Kane's testimony quoted in the opinion of the Court of Appeals, 283 Fed. 83, 94.

[3] See for example Volume I, pages 418, 419 of the record in the *Webster* case.

because of his unreasonable and unexcused delay of more than five years in claiming the invention after the issuance of the Podlesak patent. The conclusion of the Court is stated in the following language (264 U. S. 463, 471):

> "Our conclusion, therefore, is that in cases involving laches, equitable estoppel or intervening private or public rights, the two-year time limit *prima facie* applies to divisional applications and can only be avoided by proof of special circumstances justifying a longer delay. In other words, we follow in that respect the analogy furnished by the patent reissue cases."

The special rule of the *Chapman* and *Webster* cases is not applicable here:

Since the present case does not involve laches, equitable estoppel or intervening rights, the special rule of the *Chapman* and *Webster* cases would not apply even if broader claims to the subject matter in question had not been presented in the original Arnold applications.

In the courts below and also here[1] petitioner has seized upon the words "public rights" in the above quotation from the *Webster* case and insisted that in the present case the public acquired intervening rights because of the patentee's public use of the inventions. As appears above, in the *Webster* case the invention had been put into general use by the defendant which not only had acquired "intervening private rights" of its own but through its action resulting in the *general* use of the invention the public also had acquired "intervening public rights". Elsewhere, the opinion clearly shows that the Court did not have in mind public use confined to the patentee himself. For example, on pages 465 and 466, it was said:

> "We are not here dealing, therefore, with the simple case of a division of a single application for several independent inventions, Patent Office Rules 41 and

[1] Brief, pages 50, 51.

42; *Bennet* v. *Fowler*, 8 Wall. 445, 448; *American Laundry Machinery Co.* v. *Prosperity Co. Inc.* 295 Fed. 819, but with a case of unreasonable delay and neglect on the part of the applicant and his assignee in bringing forward claims broader than those originally sought. * * * We have no hesitation in saying that the delay was unreasonable, and, under the circumstances shown by the record, constitutes laches, by which the petitioner lost whatever rights it might otherwise have been entitled to."

And on page 467, quoting from one of the reissue cases, this Court said that one "'who seeks to revive his right which he has allowed to lie unclaimed'" is disabled by laches "'from enforcing it to the detriment of those who have, in consequence, been led to act as though it were abandoned.'"

In the *American Laundry Machinery* case (295 Fed. 819; C. C. A. 2), cited with approval in the *Webster* case, *supra*, the defendant moved to dismiss the complaint because the complaint did not allege that the invention had not been in public use for more than two years prior to the filing of the divisional application. The court held that such allegation was not necessary and denied the motion. In the opinion by Judge Hough, the court said (pp. 821, 822):

"In other words, and in this case, the inventor might have made, used in public, and sold his invention on the day after he filed his application on June 7, 1916, and then, because he acquiesced in a divisional ruling in 1919, invalidated *in limine* whatever he requested by the 'separate' application provided for by the rule and known to the profession long before the present code of patent practice. And this is said to be the peremptory rule of the *Chapman* Case, *supra*. We feel assured that no such rule exists.

"First. There is no intent shown by that decision to overrule earlier cases dealing with divisional applications in no 'hostile spirit'. Some are cited with approval at page 137 of the report. Divisional and

renewed [continuation] applications (absent intervening rights) should logically be treated alike. See Godfrey *v.* Eames, 1 Wall. 317, 17 L. Ed. 684; Smith *v.* Goodyear, 93 U. S. 486, 23 L. Ed. 952.

"Second. The decisions in this and other circuits, distinctly holding the contrary of the rule asserted, were not overruled or adverted to. Victor, etc., *v.* American, etc., Co., 145 Fed. 350, 76 C. C. A. 180; General, etc. Co. *v.* Continental, etc., Co. 256 Fed. 660, 168 C. C. A. 54; Rosenwasser *v.* B. E. Mfg. Co. (C. C. A.) 264 Fed. 114. Some of these cases treat of renewed applications; however, they show the analogy, and we might rest decision, so far as we are concerned, on the last citation. *It cannot be thought that the court intended to overset without comment the whole current of authority, something so firmly established that it had long passed unchallenged into text-books.*"

In the case of *Wirebounds Patents Co.* v. *Saranac,* 37 F. (2d) 830, this Court's decision in the *Webster* case was specifically interpreted by the Court of Appeals for the Sixth Circuit as *not* applying where, as here, the public use of the invention has been *confined to the patentee and those having rights from him.* In that case the court said (p. 841):

"This case is plainly not within the Splitdorf rule, as we understand it, either by parallelism or by strict analogy. Defendant points out, as a general analogy, that the machine and method had been in public use by the applicants, who became the patentees, and under licenses from them, all for more than two years before the divisional application was filed. This is true. When it is remembered that the divisional application is normally entitled to the benefit of the original filing date, it is not easy to see how public use *under license from the applicants* can amount to that laches under which *adverse* rights may arise; or now the Splitdorf rule can apply unless the delay is after the public appearance of *an adverse claimant,* or, perhaps, one who may be an adverse claimant; * * *"

same interpretation was also placed upon the *Webster* in the two *American Chain* cases,[1] and in the case *Dubilier Condenser Corp.* v. *Radio Corp.*, 34 F. 450, 462, decided by Judge Morris in the Dis- of Delaware. In the latter case it was contended the Dunmore patent No. 1,635,117, which was issued n original and not a divisional application, was invalid r the doctrine of the *Webster* case because the pat- e had published a full description of the patented ntion more than three and one-half years before he rted the claim in suit which claim was for *broader ect-matter not previously claimed.* Distinguishing the from the *Webster* and other cases, the court said 462):

"But, unlike those cases, in the suit at bar there was no delay of more than two years after *others* had entered the field, and there is no presumption that Dunmore had knowledge of defendant's loud speaker, or that the amendment was motivated by it."

s pointed out by Judge Hough in the opinion in the *erican Laundry Machine* case, *supra,* (pp. 822-823):

"• • • What the Office and all the courts were consid- ering in the Chapman Case was the evil of applicants who had not claimed, watching the published art, and demanding interference with men whose patents quite likely suggested to them, what they might have done. Such men can only be disciplined under existing statutes, by somewhat drastic imputations of laches, or establishing estoppels, • • •.

"• • • The ordinary difficulty with divided, renewed, and sometimes even amended applications, is that they are efforts to validate something that was not carved out of anything but second thoughts, and cannot be called amendments of any original. This case is wholly free from such objections."

so is the case at bar.

American Chain Co. v. *Franklin-New York Co.*, 34 F. 551, (E. D. N. Y., Campbell, *J.*), and *American Chain* v. *Stewart-Warner Speedometer Corp.* (S. D. N. Y.), ded by Thacher, *J.*, December 26, 1928, unreported.

The very object of the patent laws is to encourage the use of new inventions. It is perhaps unnecessary to state that this object would not be promoted by a decision applying the special *Webster* rule against a patentee upon the basis of his own prior use, even in cases where the patentee failed to claim the invention either broadly or specifically before filing his divisional or continuation application. If such were the law no patentee could safely make his invention available to the public even after he had fully complied with the statute by filing an application disclosing it. He would have to wait until such time thereafter that he could be certain that it would not be necessary for him to file any continuation or divisional applications to protect his invention. In *Chapman* vs. *Wintroath*, 252 U. S. 126, 132, in which this Court upheld Chapman's right to make the claims in his divisional application, six years had elapsed after the original application was filed before Chapman realized it was necessary for him to file the divisional application to protect his invention. Here only four years elapsed before one of the continuation applications was filed and three and one-half years before the other was filed.

It should be noted that under the Patent Office Rules[1], which have the force of law,[2] the Patent Office may require division of an application at any time during its

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[1] "42. If several inventions claimed in a single application be of such a nature that a single patent may not be issued to cover them, the inventor will be required to limit the description, drawing, and claim of the pending application to whichever invention he may elect. The other inventions may be made the subjects of separate applications, which must conform to the rules applicable to original applications. If the independence of the inventions be clear, such limitation will be made before any action upon the merits; otherwise it may be made at any time before final action thereon, in the discretion of the examiner. * * *"

[2] R. S. 483; 35 U. S. C. 6.

prosecution before final action on the application.[1] Such requirements are frequently made late in the prosecution of an application and are beyond the applicant's control.[2]

Frequently an inventor is unable to identify with any degree of certainty, at the time an application is filed, the particular parts or features of his work which constitute his patentable inventions. The very purpose of the ensuing prosecution of the application is to enable the inventor and the Patent Office Examiner to determine in light of the prior art cited by the Examiner precisely what invention or inventions are disclosed and can be claimed, either in one or two or more applications.

In *Bennet* v. *Fowler*, 8 Wall. 445, 448, this Court said:

> "It is difficult, perhaps impossible, to lay down any general rule by which to determine when a given invention or improvements shall be embraced in one, two, or more patents. Some discretion must necessarily be left on this subject to the head of the Patent Office. It is often a nice and perplexing question."

Accordingly it has always been the practice of the Patent Office to grant patents on continuation or divisional applications for subject-matter disclosed by the inventor in his original application even though not claimed therein,

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[1] The Official Annual Reports of the Commissioner of Patents for the years 1916 (p. xiii), 1917 (p. x) and 1918 (p. xi) show that during the years 1915 to 1918, inclusive, approximately every twelfth applicant was required by the Patent Office to file a divisional application to protect his complete invention. More recently this has increased to every eighth applicant. These figures take no account of the many additional divisional and continuation applications which have been filed voluntarily by applicants before a requirement of division has been made, as in the cases of the continuation applications for the two Arnold patents here involved.

[2] *American Laundry Mch'y Co.* v. *Prosperity Co.*, 295 Fed. 819, 821.

and even though the inventor may have put his invention into public use more than two years before his continuation or divisional application was filed.[1]

The two Arnold patents here attacked fall under the *general* rule, quoted above from this Court's decision in the *Chapman* case,[2] that a divisional or continuation application is "given the filing date of the earlier [application disclosing the invention], with all of its priority of right." Under this rule those patents are entitled to the filing dates of their respective original applications. Therefore, respondents' own public use of their inventions, which was not two years prior to those dates, is not a defense against the validity of their claims.

This would have been true even if the inventions of those claims had not been claimed in the original Arnold applications at all.[3] The fact that broader combinations were claimed in those applications, affords an additional controlling reason why the special rule of the *Webster* case is not applicable here.[4]

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[1] See *Von Recklinghausen* v. *Dempster*, 34 App. D. C. 474, 476, 477, decided by the Court of Appeals of the District of Columbia, and cited with approval by this Court in *Chapman* v. *Wintroath*, 252 U. S. 126, 137, *supra*, page 78.

[2] *Supra*, page 77.

[3] *Supra*, page 76.

[4] In *Wagenhorst* v. *Hydraulic Steel Co.*, 27 F. (2d) 27 (C. C. A. 6), the court distinguished from the *Webster* case on this latter ground, saying (p. 32):

> "Wagenhorst's amended divisional claim restricted his claimed invention to the specific form of its concrete embodiment. *This is a very different thing from the enlargement in the Webster case.*"

It is to be noted that the two-year rule of the reissue cases, relied upon as an analogy in the *Chapman* and *Webster* cases, is limited to broader reissues, that is, reissues in which the new claims are broader than those of the original patent. A patentee may obtain a valid narrower claim in a reissue patent at any time before the original patent expires. Walker on Patents (6th Ed.), page 353.

The only cases, in addition to the *Webster* case, relied upon by petitioner are *Westinghouse Electric & Mfg. Co.* v. *Jeffrey-DeWitt Insulator Co.*, 22 F. (2d) 277, *Otis Elevator Co.* v. *Atlantic Elevator Co.*, 47 F. (2d) 545, and *Crown Cork & Seal Co.* v. *Guttmann*, 86 F. (2d) 698. All of these cases were decided by the Second Circuit Court of Appeals prior to the decision by that court in the present case, and are distinguished in the opinion in this case.[1] The *Crown* case is set for argument in this Court immediately preceding the present case.

The *Otis* case was the ordinary case of a *broadened* reissue patent in which the intervening adverse use was that of a third party, rather than the defendant's own use, and had existed for more than two years before the reissue was applied for.

In the *Westinghouse* case the patent in suit had issued on a divisional application which was filed more than two years after the *defendant had itself commenced the sale of the infringing device* and the invention had not been claimed until the divisional application was filed.

In the opinion in the *Crown* case, the court below pointed out that the patentee had deliberately cancelled the subject-matter of his divisional patent in suit from the specification of his original patent which issued more than two years before the divisional application for the patent in suit was filed; that the patentee was stirred into filing this divisional application by the issuance a year before to another of a patent claiming the invention; and that had it not been for the appearance of this competitor's patent the patentee of the patent in suit might never have considered the subject-matter worth claiming as an invention.[2] And in the present case, commenting upon

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[1] III, 1721, 1722.

[2] 86 F. (2d) 698, 702.

its opinion in the *Crown* case,[1] the court below added that the patentee in the *Crown* case "had really abandoned the invention". Although it does not appear from the opinion in the *Crown* case, it is stated in the brief for the petitioner in that case submitted to this Court that the patentee had pending in the Patent Office, during the time between the issuance of his original patent and the filing of the application for his divisional patent, another divisional application which disclosed but did not claim the invention. We understand that it is mainly because of this fact that the petitioner in the *Crown* case contends that the decision in that case is in error.

There was no unusual or unnecessary delay in the present case:

Finally, it should be made entirely clear that in the present case there was no unusual or unnecessary delay before the continuation applications were filed. As we have seen, one of the original applications for the Power Circuit Patent issued in 1915[2] with claims for different subject-matter which the Patent Office promptly allowed. The other original application, which contained the broad claims, was several times rejected by the Patent Office and its prosecution was delayed by several interferences which were ultimately dissolved.[3] The continuation application was voluntarily filed as soon as it became apparent to the applicant that the broader claims would not be allowed or would be allowed only after continued prosecution. By voluntarily filing the continuation application the applicant facilitated the prosecution and the patent was promptly granted on January 27, 1920.[4]

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[1] III, 1722. [2] III, 1455.

[3] See the file history of this application, II, 1239-1304.

[4] Petitioner repeatedly refers to the fact that the continuation applications here involved were voluntarily filed by Arnold. Arnold not only had the right to do this under the practice which has existed since prior to this Court's

The original application for the Definite Input Impedance Patent, which contained the broad claims directed to the same subject-matter of invention as the claims in suit, got into interference in 1916, the year after it was filed. This interference was ultimately carried into the courts and was not finally decided until 1931[1] Instead of waiting until the termination of this interference and then prosecuting the claims in suit in his original application as he might have done, Arnold voluntarily filed his continuation application in February, 1919, when it became apparent that the interference proceeding would continue for a number of years. This resulted in the prompt issuance of the continuation patent.[2] Instead of prolonging the monopoly Arnold greatly shortened it by his action in filing this continuation application.

Respondents' public use does not affect the validity of the Arnold Power Circuit and Definite Input Impedance Patents.

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decision in 1863 in *Godfrey* v. *Eames*, 1 Wall. 317, 325, 326, but his action resulted in the earlier grant of the patents. See also *Chapman* v. *Wintroath*, 252 U. S. 126, 132, and *Overland Co.* v. *Packard Co.*, 274 U. S. 417, 419, in both of which the divisional applications approved by this Court were voluntarily filed.

On page 48 of its brief petitioner makes a general statement that all claims cancelled from the original applications for the Arnold patents were cancelled without reservation. The statement means nothing as to the matter in question. On the same page petitioner also states that patent No. 1,504,537, held invalid in *Western Electric Co.* v. *Wallerstein*, 60 F. (2d) 723 (C. C. A. 2), issued on one of the original applications on which the Definite Input Impedance Patent is based. The claims of patent No. 1,504,537 which were held invalid in that case were for entirely different subject-matter from the claims of the above mentioned patent in suit.

[1] See the file history of this application, II, 1120-1194.

[2] II, 641.

PART IV.

Each of the patents in suit is valid.

As this Court stated in *Thomson Co.* v. *Ford Motor Co.*, 265 U. S. 445, 446:

> "• • • The question whether an improvement requires mere mechanical skill or the exercise of the faculty of invention, is one of fact; • • •."[1]

In the instant case, both of the lower courts have concurred in finding that each of the patents now before this Court[2] involves patentable invention and is therefore valid. There is no conflicting decision by any other Circuit Court of Appeals. Therefore, in the language of the *Thomson Co.* v. *Ford Motor Co.* decision, page 447, this case calls for

> "the application of the well settled rule that the concurrent findings of the lower courts on questions of fact will be accepted by this Court unless clear error is shown" (citing cases).

There is no such showing here.

Furthermore, as we have said, none of the reasons urged by petitioner for the granting of the writ in this case, touched in any way the findings below that the patents disclose invention.[3]

Under all of these circumstances, we recognize that this Court may not wish to review these findings. But if it does, we believe that it will find them sound and fully justified by the record.

At the outset of this discussion of the validity of respondents' patents over the prior art, it should be noted that this petitioner, which is now attacking the validity of these several patents, concedes that the inventions of

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[1] To the same effect, see *Concrete Appliances Co.* v. *Gomery*, 269 U. S. 177, 180.

[2] There are *six* of these patents, not *seven* as petitioner's brief states (p. 54).

[3] *Supra*, page 7.

heir claims are embodied in its amplifiers, and concedes he usefulness and commercial success of those inventions.[1] Indeed, petitioner states[2] that its amplifiers which mbody the inventions are useful "in any industry where economical, substantial and reliable amplification of electric current is desired". Furthermore, before purchasing ts amplifiers from the Transformer Company, petitioner ook pains to ascertain[3] that that company had a license nder "the R.C.A. patents" (which include the patents ere in suit). And petitioner then conspired with that ompany in causing it to exceed the limitations of that icense, by selling to petitioner for theatre use, amplifiers f the high quality that can be secured only by the employment of the inventions of these patents.

We suggest that under these circumstances the present ontention that these patents are invalid for lack of invention comes with ill grace from this petitioner.

In considering the various questions of inventiveness ere presented, it must be remembered that the contributions covered by the several patents in controversy were nade at the very beginning of this art, the earliest in 912, and the latest in 1916. Now that this art has become commonplace, it is not easy to project one's self back to hose early days when it was almost entirely empirical nd when the *modus operandi* of three-element vacuum ube was shrouded in mystery. But it is in the light of heir early day environment that the inventive character f these contributions must be appraised. They must be valuated "with the 'eye and understanding' of those n the field when they were made."[4]. The Court must seek to recover the realities of a situation long past."[5]

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[1] *Supra*, page 5.

[2] Brief, page 12.

[3] II, 731.

[4] *Cleveland Trust Company, et al.* v. *The Schriber-chroth Company* (C. C. A. 6), decided October 8, 1937, nd not yet reported.

[5] *Minerals Separation, Ltd.* v. *Butte & Superior Mining o.*, 250 U. S. 336, 345

We shall now consider each of these patents separately in the order in which they are listed above.[1] The Lowenstein Negative Grid Bias Patent comes first because it is the earliest, in point of filing date. Then comes the Mathes patent because it is a specific improvement upon the Lowenstein invention. And then the four Arnold patents in the order of their original filing dates.

1. The Negative Grid Bias Patent (Lowenstein).

This patent, No. 1,231,764,[2] was granted in 1917 upon an application filed in 1912. It expired in 1934. The claims in suit are 1, 2, 4, 5, 6 and 7. All of them were sustained in the Circuit Court of Appeals for the Second Circuit in *Western Electric Co., et al.* v. *Wallerstein*, 60 F. (2d) 723, and claims 1 and 7 were sustained in an earlier case, *Radio Corp. et al.* v. *Bunnell, et al.* (D. C. S. D. N. Y.), 22 F. (2d) 847, from which no appeal was taken.

Lowenstein's invention consisted essentially in the discovery that if the grid of the three element vacuum tube, when used as an amplifier, is made to operate by *potential* and not by *current*, the distortion produced in the input circuit by *current* (and reproduced in amplified form in the output circuit) could be prevented, and that operation exclusively by *potential* could be attained by the application to the grid of a suitable initial *negative* potential on which the signals to be amplified are superposed.

The direct result of this invention was vastly improved faithfulness of reproduction, accompanied by a greatly increased undistorted output.

In the case of *Western Electric Co. et al.* v. *Wallerstein*, 60 F. (2d) 723 (C. C. A. 2), in which the court below sustained this Lowenstein patent, that court said (p. 726):

> "This contribution to the art has been of great merit."

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[1] *Supra*, page 2.

[2] II, 615.

Referring to the lower portion of Fig. 1 of the Lowenstein drawing,[1] we shall first outline the general manner of operation of the three-element vacuum tube, when used as an amplifier.

The tube 15 consists of an evacuated glass envelope containing a filament (cathode) 16, a plate (anode) 17, and a grid 18. The input, or grid, circuit consists of the filament, the grid and the connections between them. The battery 19 (the "A" battery) furnishes current to heat the filament to incandescence, causing it to emit negative electrons. The output, or plate, circuit consists of the plate, the filament and the connections between them, which include the "B" battery. In the Lowenstein drawing the "B" battery is the portion of the battery 21 between the two arrow heads. This battery maintains the plate positive with respect to the filament. As a result, the plate attracts the negative electrons emitted by the incandescent filament, causing a current to flow through the output circuit.

When no signals are being received by the input circuit, the current flowing in the output circuit is constant. But when signals, in the form of alternating currents or potentials are applied to the grid, they vary the electrostatic field between the filament and the plate. This causes a variation in the electronic flow from the filament to the plate and therefore in the current flow in the output circuit. Very slight variations of grid current, or potential, will be more or less faithfully repeated in the plate circuit in the form of a pulsating direct current of greatly increased amplitude and energy, as compared with the incoming signals, owing to the high power furnished by the plate battery. The tube, therefore, acts as an amplifier.

In the Lowenstein drawing, the incoming signals are imposed upon the input circuit of the tube at the trans-

[1] II, 615.

former 12, 13; the output is through the transformer 22, 23.

Lowenstein's addition to the circuit which has just been described, was the negative grid bias potential (the "C" battery), which appears in his drawing as the portion of the battery 21 lying to the right of the right hand arrow head. The grid, instead of being connected directly to the filament by the wire extending from the grid, through 13, was now connected by that wire to the negative terminal of the added battery, and the positive terminal of that battery was connected to the filament.

As a result, there was impressed upon the grid (or "modulating device" as Lowenstein calls it in some of his claims[1]) a potential *more negative* than that of the filament (or "cathode"). Since the negative electrons emitted by the filament, will be attracted only by objects having a potential *more positive* than that of the filament, Lowenstein's scheme of biasing the grid negatively, prevented the flow of electrons from the filament to the grid and thereby eliminated distorting current flow in the input circuit. The grid now became subject to *poten-*

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[1] II, 617, 618. Claims 1 and 7, for example, read:

"1. Telephone apparatus comprising the combination, with a talking circuit, of a suitably energized relay circuit including an anode and a cathode separated by a conductive gap, a modulating device interposed in said gap and electrically connected with said talking circuit, *means for impressing upon said modulating device a potential more negative than that of said cathode,* and a translating device arranged to be energized from said relay circuit.

"7. The combination, with an audion having its anode and cathode included in a suitably energized circuit, of *means for impressing upon the audion grid a potential more negative than that of the audion cathode.*"

tial variations only, and the tube became a *potential* operated device instead of a *current* operated device.

Lowenstein was, unquestionably, the first to teach the negative grid bias. Since his discovery of it, it has been used virtually universally.

In its attack upon the validity of the Lowenstein patent, petitioner's primary reliance is upon the patent to Stone No. 884,110 of 1908.[1] This patent does show a battery Z in the input circuit. But, as petitioner concedes,[2] that battery has its *positive* terminal connected to the grid, not its *negative* terminal.[3] Therefore, as was said in the *Bunnell* case,[4] "if it teaches anything, it teaches the reverse of the Lowenstein claims." A *positive* bias of the grid, which would be the result of the Stone arrangement, would serve to *increase* the distorting current flow in the input circuit, instead of eliminating it, as Lowenstein's negative grid bias does.

DeForest patent No. 841,387,[5] to which petitioner also refers, is equally barren of any suggestion of a negative grid bias. Petitioner refers particularly to the battery "B" of Fig. 2 of this DeForest patent. The most it can say about that battery is that the patent gives *no* designation of its polarity. This, in itself, disposes of this DeForest patent as a defense, for "the burden of proving want of novelty is upon him who avers it" and "his burden is a heavy one, as it has been held that 'every reasonable doubt should be resolved against him'."[6] Furthermore, petitioner's expert conceded[7] that with the detectors used at the time of this DeForest patent, it was customary to employ a sensitizing battery to keep the detector in a sensitive condition, and that for this purpose it would be

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[1] II, 1432.
[2] Brief, page 66.
[3] I, 224, 225.
[4] 22 F. (2d) 847, 849.
[5] III, 1424.
[6] *Mumm* v. *Jacob E. Decker & Sons*, 301 U. S. 168, 171.
[7] I, 300.

necessary that the battery be poled with its *positi* terminal connected to the grid. Under no circumstanc could this DeForest patent be deemed an anticipation the Lowenstein negative grid bias invention.

As a final comment on this Lowenstein patent, petition says that from the earliest days of the audion art, "t filament of the audion tube was *always* heated from battery *so connected that its negative terminal would connected to the grid electrode* (see DeForest Patent, N 879,532—Rec. p. 1428, Figs. 1 and 2; DeForest Paten No. 995,126—Rec. p. 1435, Figs. 1 and 2)"[1] (Emphasis petitioner's). But petitioner neglects to state, that i each of these Figs. the negative terminal of the battery connected to the grid *through a condenser* which, in effec breaks the circuit—so far as direct current is concerned— so that "the grid gets no polarization or potential" fro this source.[2] Even if the condensers were not interpose "the grid would have the normal potential of the nega tive end of the filament" and would not be "ultra negative", *i. e.*, would not be more negative than any pa of the filament, which is what Lowenstein taught.[3]

In the *Wallerstein* case the Second Circuit Court of Ap peals concluded its opinion upon the Lowenstein patent, a follows:[4]

> "• • • Lowenstein made a valuable contributio which has proven of great aid to mankind, particularl in the art here under consideration. The defendan has adopted it, and thereby infringes. This patent i therefore held valid and infringed."

That Court reached the same conclusions in this case. We submit that in doing so, it committed no error.

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[1] Brief, page 67. [2] I, 418.

[3] *Id;* also *Wallerstein* decision, 60 F. (2d) 723, 726.

[4] 60 F. (2d) 723, 727. [5] III, 1714.

2. The Grid Biasing Resistance Patent (Mathes).

The Mathes Patent No. 1,426,754[1] was issued in 1922, upon application filed in October, 1916. It will, therefore, expire in 1939. The patent discloses *two* inventions with only one of which this case is concerned.

By the invention here involved Mathes made it possible to gain the important advantages of the Lowenstein invention without the disadvantage of using an extra battery. He accomplished this by making the filament heating or "A" battery serve, in combination with a resistance placed in the filament heating circuit, the additional function of biasing the grid. The usefulness of this invention has been thoroughly demonstrated by its extensive use. The invention is defined in claim 8, the only claim in suit, as follows:

> "8. In an electric translating circuit, an electron discharge device having a cathode, and an anode and an auxiliary electrode, said auxiliary electrode and said cathode being in the input circuit of said tube, a source of current connected to said cathode, a resistance, *a circuit containing said cathode, said source and said resistance in series, said resistance being also included in the input circuit of said tube in such a manner that the potential of said auxiliary electrode is normally maintained lower than any part of said cathode by an amount substantially equal to the drop in said resistance, said cathode being rendered thermionically active by current flowing in said series circuit.*" [2]

As is apparent from the italicized portion of this claim, it defines the specific and very useful series circuit combination of grid biasing resistance, filament heating battery and filament, the grid biasing resistance being included in

[1] II, 619. [2] II, 623.

the same circuit as the filament and filament heating battery.

This arrangement is shown in Mathes' Figure 1,[1] in which the grid biasing resistance is shown at 9, the filament at 3 and the filament heating battery at 6. In operation, current flows from the positive or right-hand end of the battery up through the filament 3, thence through the resistance 9, and back to the negative end of the battery through the regulating resistance 15 and choke coil 14 which resistance and choke may be disregarded for present purposes. The result is that the left-hand end of the resistance 9 is at a lower potential than any part of the filament, as is also the grid 7, the grid being connected to the left-hand, low potential, end of the resistance 9 through part of the resistance 10.

As before stated, claim 8 in suit was held valid and infringed in the *Bunnell* case.[2]

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[1] II, 619.

[2] 22 F. (2d) 847. The Mathes paten was also involved in the *Wallerstein Case,* 60 F. (2d) 723, but not claim 8 or its subject-matter. The feature of Mathes' invention that was involved in that case is covered by the second object of the patent, namely a method "for compensating for fluctuations in the potential of the output [plate] circuit battery of the vacuum tube" (pat. p. 1, lines 19-21, II, 621). That feature is disclosed in Fig. 3 of the patent and defined in claim 25, the only claim in suit in the *Wallerstein Case.* That court held that claim 25 was not infringed, pointing out that Mathes did not supply the grid voltage from a *plate* current source, as in the alleged infringing amplifiers. The decision has no bearing on the subject-matter of claim 8 in suit. That claim as we have seen is not a broad claim for obtaining negative grid bias by means of a resistance, but for *the specific and very useful series circuit combination of biasing resistance, filament heating battery, and filament. The statement in petitioner's brief* (p. 63) *that claim 25, held not infringed in the Wallerstein Case, is "directed to the same subject-matter", as claim 8 here in suit, is obviously untrue* (III, 1651).

At the trial, petitioner's expert selected the Arnold patent No. 1,129,942[1] as the best reference with respect to this Mathes patent.[2] And petitioner discusses that patent first in its brief here,[3] relying primarily upon Fig. 6.

We find no suggestion in the record that this Arnold Fig. 6 embodies the Mathes grid biasing resistance invention. As we have seen, the whole purpose of that invention was to eliminate the necessity for a grid biasing battery. Yet the only testimony by petitioner's expert having any bearing at all upon the present issue is that in Arnold's Fig. 6 *the battery 11* "furnishes the necessary negative bias of this combination".[4]

The resistance 14, upon which petitioner apparently relies as performing the function of the Mathes grid biasing resistance, does not, and cannot, perform that function because the condensers 18 prevent any flow of direct current through it, from the filament heating battery 12.

Arnold patent No. 1,129,943,[5] upon which petitioner relies also, is equally far afield. The specification of that patent specifically points out that the *batteries* 6 are of such value as to give the desired negative bias to the grids.[6] There is no resistance in the circuit of heating battery 7 which tends to impart a negative bias to the grids. Indeed, as respondents' expert explained, the batteries 6, in order to provide the desired negative grid bias, must first "overcome the voltage of battery 9".[7]

It is significant that petitioner is unable to refer to any testimony in the record, which supports its contentions regarding these prior Arnold patents. Concerning these patents, the Court below properly found:[8]

> "* * * Instead of teaching that Lowenstein's battery can be dispensed with, these Arnold patents

[1] III, 1453.
[2] I, 302.
[3] Page 64.
[4] I, 263.
[5] III, 1459.
[6] III, 1461, ll. 36-40.
[7] I, 423, 424. Apparently it was to avoid this additional demand upon the grid biasing batteries that the blocking condensers 18 were provided in Fig. 6 of Arnold patent 1,129,942, discussed above (III, 1457, ll. 25-32).
[8] III, 1715.

teach that it should be used and they do not teach, as Mathes provides, that the filament heating battery can serve the additional function of biasing the [fol. 1717] grid if the biasing resistance is included in the series in the filament heating circuit."

The Colpitts *et al.* patent No. 1,338,450[1] discloses in the right-hand portion of Fig. 2 the resistance 64. This resistance is *not* in the filament heating circuit, as was admitted by petitioner's expert.[2] Furthermore, this arrangement is inherently defective because the resistance 64 tends to compensate out or eliminate the signal which it is the whole purpose of the amplifier to strengthen. As respondents' expert testified,[3] and the court below found[4] the resistance 64 "has a deamplifying effect • • • which makes it highly objectionable in an amplifier".

Mathes made a distinct contribution to the art in his particular series arrangement of grid biasing resistance, filament and filament heating source, as claimed in claim 8, which secures the negative grid bias without adding a battery for that purpose.[5] This claim has now been twice sustained by District Courts, and once by the Circuit Court of Appeals. We submit that it should be held valid here also.

3. The Power Circuit Patent (Arnold).

This Arnold patent No. 1,329,283[6] issued in 1920 upon an application filed July 30, 1918, which was a continuation of two earlier applications filed May 28, 1914. The patent expired last January, pending the appeal.

As we have seen, the three electrode vacuum tube, during its entire existence from 1906 until it came into Arnold's hands in 1912, had remained a mystery. Neither DeForest nor others had been able to throw any light on its internal characteristics. It had remained purely

[1] III, 1531.
[2] I, 305.
[3] I, 427.
[4] III, 1715.
[5] *Id.*
[6] II, 628.

an empirical device and in the form in which it had been built was inadaptable to either high voltage amplification or large current output and could yield only a trifling amount of power.

Arnold discovered and in this patent disclosed not only the fundamentals of the tube's operation but how to construct it so as definitely to adapt it to utilization in circuits and with other circuit elements to give the most efficient results. He showed how to produce at will tubes having the desired characteristics, and how to determine in what circuit arrangements particular types of tubes should be used to do the work at hand. This work was fundamental and pioneer in character, and its useful results have been far reaching. *With the possible exception of the DeForest audion patent, there is no patent in this art which exceeds in the importance of its contribution that of the Arnold patent under consideration.*

Referring to the high current or power tube disclosed in this Arnold patent, Dr. DeForest said in his 1920 Franklin Institute paper:[1]

> "• • • Such rapid progress was made in improvement of design and construction of these so-called 'power tubes,' notably by the engineers of the Western Electric Co., that by autumn of 1915 a bank of several hundred tubes, their input and output electrodes connected in parallel, were installed at the Arlington wireless station. • • • By this arrangement the voice was transmitted that year as far as Honolulu and Paris, thus fulfilling predictions made in 1909 to a very skeptical world."

The broad object of the Arnold invention is stated at the beginning of the specification as follows:[2]

> "This invention relates to thermionic amplifiers of the audion type, and its object is to provide a structure by which certain desired characteristics of the amplifier may be secured at will and in an efficient

[1] II, 712.

[2] II, 628, ll. 10-19.

manner. This object is accomplished by proportioning the geometrical and electrical relations of the various elements of the device in a manner more fully explained later in this specification."

The concepts and constructions as well as the results that Arnold was about to express were wholly new. The art had no generally understood terms which could be used. Arnold accordingly had to make his own vocabulary. He therefore proceeded to define a number of terms which he would use including what he meant by a high voltage amplifier tube and a high current amplifier tube. If the ratio between the output voltage and the input voltage is high the tube is a high voltage amplifier. If the ratio of the output current to the input voltage is large the tube is a high current amplifier or power tube.[1] As stated in the next paragraph of the specification,[2] Arnold found that——

> "amplifiers may be designed for given circuit conditions so that they will have whichever of the above mentioned characteristics is desired. That is; one may be designed to deliver to a receiving device a comparatively high voltage with a low current, or vice versa. The principles of operation which have been discovered which enable this result to be accomplished may be stated as follows."

The principles of operation referred to are those utilized in the inventions of the claims in suit. They may be summarized as follows:

First Principle: Locate the grid as near as possible to the filament for all purposes.

Second Principle: Space the plate and filament widely apart for high voltage output and closely together for high current output.

Third Principle: Use a fine mesh grid for high voltage output and a coarse mesh grid for high current output.

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[1] II, 628, l. 96 to 629, l. 6. [2] II, 629, ll. 6-15.

Fourth Principle: For maximum efficiency, construct the tube so that its internal impedance between the plate and filament "is equal to the total impedance of the variable current consumption circuit",[1] *i. e.*, the external or work circuit. *That is, the internal impedance between the plate and filament of the tube should equal or match the impedance of the external circuit, including the receiving or translating device to which power is to be supplied.*

We are here concerned with the application of these principles in producing an amplifier with a high current or large power output, such as petitioner's amplifiers. Greater power is required to drive the loud speakers of public address and talking motion picture systems than is required for radio or telephone. Indeed, without the power amplifier disclosed in this Arnold patent, public address and talking motion picture systems could not be successfully operated with any loud speaker yet devised.

The high voltage amplifier is illustrated in Fig. 1 of the patent[2] in which the grid 1 is of fine mesh and the plate 3 widely spaced from the filament 2. The large power tube, or high current amplifier, is shown in Fig. 3, with the plate 3a spaced as closely as possible to the filament 2a and the grid constructed of coarse mesh. The complete amplifier is shown in Fig. 10[3] in which the tube V^1 is a large power tube with a coarse mesh grid and its output circuit is coupled by the transformer 17-18 to the work circuit containing the receiver 15. As explained in the Arnold patent the tube of Fig. 10 is of the high current type whose low output impedance is matched to the low impedance of the external or work circuit.[4]

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[1] II, 629, ll. 65-66.

[2] II, 626.

[3] II, 627.

[4] II, 631, ll. 30-46.

The Claims:

Claims 7, 10 and 13 in suit are quoted in the margin.[1] Each is for the novel combination of a power or high current three-electrode vacuum tube of low impedance with a work circuit having low impedance of the same order of magnitude. Claim 7 specifies that the three elements of the tube are "so spaced that the impedance of said discharge device [tube] between said anode [plate] and said cathode [filament] is of the same order as that of said outgoing [work] circuit." Claim 10 is even more specific,

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[1] II, 632. "7. The combination with a thermionic discharge device having a cathode, an anode and a control element, of an input circuit therefor, and an outgoing circuit having impedance and connected to said anode and cathode, said cathode, anode and control element being so spaced that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

"10. The combination with a thermionic discharge device having a cathode, an anode, and a grid, of an input circuit connected to said cathode and said grid, an outgoing circuit having impedance and connected to said anode and cathode, a source of electromotive force in said outgoing circuit, and means for impressing a varying electromotive force upon said input circuit, said cathode being placed in immediate proximity to said grid but out of electrical contact therewith, and said anode being so spaced from said cathode and grid and the said grid being of such coarse mesh that the impedance of said discharge device between said anode and said cathode is of the same order as that of said outgoing circuit.

"13. The combination with a thermionic discharge device having an anode, a cathode, and an impedance varying element, of an input circuit connected to said impedance varying element, a source of variable electromotive force in said input circuit, a source of electromotive force connected to said anode and cathode, and a work circuit connected to said anode and cathode, the impedance of said discharge device between said cathode and anode being of the same order as that of said work circuit."

stating that the filament is placed in immediate proximity to the grid, and that the plate is so spaced from the filament and the grid made of such coarse mesh that the two impedances mentioned above are of the same order. Claim 13 is quite similar to claim 7. It adds to that claim "a source of variable electromotive force in said input circuit", that is, the signal, but does not refer to the spacing of the elements as does claim 7.

The Prior Art:

The first of the four patents upon which petitioner relies in its attempt to invalidate the claims of this Arnold patent is the Seibt patent 1,012,456.[1]

This Seibt patent had nothing whatever to do with the vacuum tube which was practically unknown when Seibt filed his application.[2]

What Seibt shows is an *arc transmitter* with a *microphone*, and all that he teaches is that in such a system a maximum output may be obtained when the resistance of the *microphone* is equal to the resistance of the rest of the system. With the simple and well-known devices which Seibt was using, this involved merely the simple transfer of electrical energy to a circuit. Even so, Seibt found it necessary to set forth a number of complicated mathematical formulæ in explanation of his disclosure.

Petitioner does not press the contention that Arnold's claims did not involve invention over this Seibt patent.[3] Both of the courts below held—correctly, we think—that the Seibt patent had no bearing upon the Arnold invention.[4]

In its effort to invalidate this Arnold Power Circuit Patent, petitioner apparently places its principal reliance

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[1] III, 1438.

[2] District Court Opinion, III, 1659; Court of Appeals Opinion, III, 1717.

[3] Brief, page 56.

[4] III, 1659, 1717.

upon another patent of Arnold, No. 1,129,943[1] which, it says contains a full disclosure of this invention. So it does. But that Arnold patent issued upon an application which was filed on the same day as the original application for this Power Circuit Patent. Therefore, it cannot be treated as an anticipation or as part of the prior art. Apparently recognizing this, petitioner places its argument on the ground that what Arnold did not claim in patent No. 1,129,943, he abandoned, and could not reclaim in the continuation application for this Power Circuit Patent which was filed after the issuance of patent No. 1,129,943, *even though it was filed while the original application disclosing the present subject matter was still pending.*[2] Petitioner cites no authority for this proposition. The authorities are the other way. *Traitel Marble Co.* v. *Hungerford Co.*, 22 F. (2d) 259 (C. C. A. 2). And see our discussion of this point in Part III of this brief.[3] Both of the courts below rejected petitioner's proposition, in the case at bar.[4]

The Colpitts patent 1,129,959,[5] upon which petitioner relies, has no bearing upon the validity of the Arnold Power Circuit Patent, because neither the Colpitts patent nor the date of its application anticipates the date of Arnold's invention. As found by the District Court, that invention was made prior to April 6, 1914, which was the filing date of Colpitts who was one of Arnold's coworkers.[6] When Arnold's earlier date of invention was established before the Patent Office, the Colpitts patent, which had been cited against the Arnold application, was withdrawn as a reference.[7] The District Court disposed

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[1] III, 1459.

[2] Brief, page 56.

[3] *Supra*, page 71.

[4] III, 1660, 1717.

[5] III, 1463.

[6] III, 1659, 1660. The record upon which this finding was based contained incontrovertible documentary evidence establishing Arnold's priority (II, 814, 817, 805-813).

[7] II, 881, 891.

of the Colpitts patent similarly. And the Circuit Court of Appeals likewise found that it did not anticipate.[1]

Petitioner's passing reference to the Langmuir patent 1,558,436,[2] does not involve any contention that it discloses the Arnold invention. All petitioner claims for Langmuir is that he pointed out that the geometric proportions of the audion tube affect the amount of current which will pass with a given voltage. That is indeed a far cry from Arnold's discovery that for maximum efficiency the tube should be so constructed that its internal impedance between the plate and filament should be equal to the total impedance of the external circuit.

The ultimate finding of the court below on this Arnold Power Circuit Patent that it "has become an important contribution to the art" and "constitutes invention",[3] is believed to be unassailable.

4. The Resistance-Capacity Coupling Patent (Arnold).

This Arnold Patent No. 1,403,475[4] issued January 17, 1922 upon an application filed November 11, 1920, which is a division of, and was copending with, Arnold's original application Serial No. 48,873, filed September 3, 1915.[5] The invention was employed in the receivers used in the 1915 Radio Telephone experiments,[6] and has since been widely used.[7] The patent will expire in January, 1939.

The patent discloses a new method of coupling the output circuit of one three-electrode vacuum tube to the input circuit of another, by which what is known as

[1] III, 1717.
[2] III, 1550.
[3] III, 1717.
[4] II, 636.
[5] II, 991.
[6] I, 107.
[7] I, 91.

frequency distortion is entirely avoided. *This new coupling made it possible for the first tube to pass on to the next all frequencies of the signals equally amplified, i. e., without distorting any of them.* By this means the lowest as well as the highest frequencies found in voice or music are equally amplified, a result that can only be obtained with resistance coupling.[1] A further important advantage of the coupling is that extremely small, as well as large, currents or energies are equally effectively passed on to the next tube. This latter advantage is of great benefit in amplifiers, used for talking motion pictures, such as petitioner's amplifiers.[2]

In such amplifiers only a very small energy is produced by the photo-electric cell when light, modulated only by the variations of density of the talking motion picture film, falls upon the cell. The energy is so small that a satisfactory and efficient coupling could not be obtained with transformers or any other known means of coupling.[3]

In the patent drawing, the first tube 21 is a detector, the output of which is to be passed along to the adjacent tube 31. The direct current path of the plate or output circuit of the first tube consists of the space between the plate 10 and filament 8, the B battery 27, the choke coil 28 and the resistance 25 which is the coupling resistance. *The voltage variation at the top of this resistance 25 corresponds exactly to the signal no matter what the frequency.*[4] The voltage variations thus created at the upper end of the resistance 25 pass to the grid of the second tube through the condenser 26. The grid of the second tube is connected to its filament through the biasing battery 30 and the resistance 29, an important

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[1] III, 1664, 1717.

[2] *Id.*

[3] I, 174, 175; III, 1664, 1718.

[4] I, 172, 173.

function of the latter being to permit the electrons, which would otherwise accumulate on the grid of the second tube and block the operation, to leak off through the resistance.[1] The principal elements of the described combination are, therefore, the coupling resistance 25 which is independent of frequency, the condenser 26 through which that resistance is connected to the grid of the second tube, and the resistance 29 which connects that grid to the filament.

Claims 8, 9 and 10 in suit are quoted in the margin.[2] Each of claims 8 and 9 specifies the resistance 25 and condenser 26 of the patent; claim 10 includes additionally the resistance 29.

Two patents are relied upon by petitioner, namely, Arnold 1,129,942,[3] and Nichols 1,257,381.[4]

Concerning the Nichols patent, petitioner says that it[5] "issued more than two years prior to the application date

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[1] I, 172, 173.

[2] II, 638. "8. In combination a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser.

"9. In combination, a circuit comprising a resistance, a source of direct current and means for producing variations in said current, a vacuum tube having input electrodes, and connections for impressing said variations on said electrodes, said connections comprising a series condenser.

"10. In combination, a circuit comprising a resistance and means for producing potential variations across said resistance, a vacuum tube having input electrodes, connections for impressing said variations on said electrodes, said connections comprising a series condenser, and a resistance shunt for said input electrodes."

[3] III, 1453.

[4] III, 1491.

[5] Brief, page 58.

(November 11, 1920) of the divisional application for the patent in suit." But that is not sufficient to make it part of the prior art. It is disqualified because it was neither issued nor filed prior to Arnold's original application disclosing this invention.[1]

Concerning the Arnold patent 1,129,942,[2] relied upon by petitioner as showing a resistance-capacity coupling amplifier, we quote the finding of the court below,[3] which we have annotated with references to the record:

> "The Arnold patent No. 1,129,942 of the prior art does not disclose a resistance capacity coupling amplifier. Defendant claims in fig. 6 the coupling between the first and second tube is a resistance capacity coupling, but it is not. It is an inductance capacity coupling as the defendant's expert admitted, referring to the difference as an essential one.[4] An inductance consisting of a wire-wound iron core, impedes the flow of alternating current, impeding high frequencies more than low, and causing distortion. The object of the patent in suit was to avoid such discrimination."[5]

Petitioner has failed to show any error in the findings of the courts below that this Arnold patent is valid.

5. The Definite Input Impedance Patent (Arnold).

This Arnold Patent No. 1,448,550[6] issued March 13, 1923, upon an application filed February 3, 1919, which is a continuation of two earlier applications Serial No. 48,873 filed September 3, 1915[7] and Serial No. 59,210 filed

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[1] *Supra*, page 109.
[2] III, 1453.
[3] III, 1718.
[4] I, 262, 263-265.
[5] I, 553; also District Court Opinion, III, 1664, 1665.
[6] II, 640.
[7] II, 991.

November 2, 1915.[1] This patent will expire in March, 1940.

The input circuit of a three-electrode vacuum tube has a very high impedance of the order of 25,000 ohms,[2] even when the grid is not biased negatively by the use of the Lowenstein invention. When that invention is used, the impedance of the input circuit becomes substantially *infinite*[3] because no electrons can flow from the filament to an electrode which is negative with respect to the filament.

For the tube to be useful, such as from the end of a telephone line or the output side of another vacuum tube, connections must be made to its input circuit so as to supply the tube with the signals to be amplified. But when such a line or preceding tube, which is of finite impedance "looks into", as the engineers express it, the input circuit of the tube, it "sees" a very high or infinite impedance. In the absence of this invention, the action that would occur in imposing the signals on the input circuit might be likened to throwing a ball against a wall from which it rebounds. The reflection back into the line or into the preceding tube, due to the high impedance encountered, may produce an echo in the telephone line which the speaker at the far end of the line will hear as an interfering echo of his own voice; it may disturb the operation of other amplifiers in the line; it may result in producing a state of resonance in the transformer at the end of the line, upsetting

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[1] II, 1120: Petitioner says (Brief, p. 59) that no effort was made to establish what part of the subject-matter of the claims in suit constitutes a continuation of these earlier applications. The file histories of those applications were offered in evidence for that very purpose, and the invention of the claims in suit is fully disclosed in the specification as filed of each application (II, 1130, ll. 23-32; 997, ll. 14-21) as petitioner admits (Brief, p. 45). The court below found that the application for this patent was "the continuation" of the 1915 application (III, 1718).

[2] II, 641, ll. 20-23.

[3] II, 641, ll. 26-35.

its operation so that it will discriminate as to certain frequencies; and it may result in what is known as "feed back" by setting up undesired oscillations which will be fed back into the line or preceding tube and interfere with their operation.[1] *All of these effects were cured by the invention of the Arnold patent under consideration.*

Referring to Arnold's patent drawing,[2] he placed a high impedance across the input terminals of the amplifier tube 2, that is, in shunt to those terminals and also in shunt to the secondary coil of the input transformer 5. The incoming line is indicated as 1. With a high impedance thus included in the input circuit, that circuit having infinite impedance, is made to look to the incoming line like a definite load of finite impedance.[3] Thus the patent is known as the Definite Input Impedance Patent.

The impedance, which is of the order of 500,000 ohms,[4] absorbs the energy which would otherwise be reflected, or cause resonance or feed-back.[5] In addition to overcoming these serious difficulties in the use of the vacuum tube as an amplifier, the invention also made it feasible for the first time to substitute indiscriminately in one circuit, tubes having different input impedances,[6] which in itself was of great practical importance.

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[1] I, 175-179.
[2] II, 640.
[3] I, 178-179.
[4] II, 641, l. 44.
[5] II, 641, ll. 78-88; I, 179.
[6] II, 641, ll. 58-62, 89-96.

Arnold's date of invention was found below to be earlier than any of the patents relied upon by petitioner:

Claims 1 and 12 in suit are quoted in the margin.[1] Claim 12 differs from claim 1 in specifying that the impedance is of the order of 500,000 ohms, as in petitioner's amplifiers.[2]

Petitioner cites three patents,[3] Colpitts 1,129,959, filed April 6, 1914,[4] Colpitts Reissue 14,380, filed May 18, 1914[5] and Van der Bijl 1,350,752, filed August 21, 1915[6] but all are later than the date of Arnold's invention as found in this case.[7]

Upon the basis of "convincing testimony" which was "fortified by records", the District Court found that Arnold's date of invention was in "the early part of March, 1914".[8] And since none of the patents relied upon by petitioner has an issue date or an application date as early as that, none of them requires consideration. The District Court so held,[9] and the Circuit Court of Appeals

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[1] II, 642. "1. The combination of a vacuum dicharge repeater of the three-electrode type, an inductive coil conductively connected to the input electrodes of said repeater, and a conductive impedance in shunt to said coil.

"12. The combination of a line, an amplifier in circuit therewith having an input impedance which is practically infinite, and a shunt between said line and said amplifier having an impedance of the order of 500,000 ohms."

[2] I, 179.

[3] Brief, pages 59, 60.

[4] III, 1463.

[5] III, 1486.

[6] III, 1507.

[7] III, 1668. Colpitts and Van der Bijl were both Arnold's associates and undoubtedly learned the invention from him. It is also noted that the two Colpitts patents were cited as references in the Patent Office and were withdrawn when Arnold swore back of them (II, 924).

[8] III, 1668.

[9] *Id.*

affirmed.[1] That court properly confined its discussion to the defense of "double patenting" which petitioner does not now urge.

No reason has been advanced by petitioner for altering the finding of both of the courts below that this Arnold patent is valid.

6. The Common Plate Supply Patent (Arnold).

This Arnold Patent No. 1,465,332[2] is the last of the patents sustained below and covers one of the most useful of the inventions. It issued on a divisional application filed August 28, 1920, which was based upon application, Serial No. 48,873, filed September 3, 1915.[3]

As was found below,[4] *the invention of this patent made it possible for the first time to use a common source of plate current for two or more three-electrode vacuum tube amplifiers without introducing prohibitive distortion.* The patent states:[5]

> "An object of this invention is to provide means whereby a plurality of vacuum tubes to be used as repeaters or amplifiers may be supplied with space current from a single source, *but in such a manner that current changes in one tube due to signals being repeated cannot be impressed upon another tube through said source.*
>
> "With the arrangement shown herein, a single source of space current is used to energize both tubes of a two stage amplifier, and in the branches of the circuit therefor are interposed filters of series inductance and shunt capacity to prevent alternating current from being bypassed therethrough."

Thus, the problem in using such a common source was to prevent that source and the connections to it from serv-

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[1] III, 1719.
[2] II, 643.
[3] II, 993.
[4] III, 1720.
[5] II, 644, ll. 12-26.

ing as a path through which the amplified signals in the plate circuit of the subsequent tube or tubes can get back into the circuits of the preceding tube or tubes, thereby setting the circuits into a state of oscillation or regeneration. When such feed back occurs the amplified signals in one tube will flow in the plate circuit of the preceding tube and through that circuit will again be impressed on the input circuit of the tube from which they came. A cycle is thus set up which will change the tube into a generator of oscillations nullifying its usefulness as an amplifier. Arnold's invention prevents this, making it possible to use a common plate or direct current supply for a plurality of tubes while preserving the alternating or signal current separateness of the output circuits of the tubes.[1]

In the patent drawing, the plate or B battery 20 supplies plate current to the plate circuits of the two tubes 10 and 11. With regard to tube 10, the specification states:[2]

> "* * * Current between the anode and cathode is supplied from battery or other suitable source 20, the current passing in series through the inductance 21 and the transformer primary 22. A shunt condenser 23 provides a path for the alternating current."

And as to tube 11;[3]

> "Direct current is supplied to the tube 11 from source 20, through inductances 28 and 29, and grounds 30 and 31. Condenser 32 is shunted across the direct current circuit. The output circuit for alternating current comprises the condenser 33 and the primary 34 of a transformer, * * *."

The functions of the inductances and condensers are stated as follows:[4]

> "The series inductances 21 and 28 and the shunt condensers 23 and 32 serve to prevent potential

[1] I, 86, 181-183.
[2] II, 643, ll. 48-54.
[3] II, *Id.*, ll. 63-69.
[4] II, *Id.*, ll. 85-89.

variations from the source or from either tube without [from] being impressed through the supply circuit on the other tube."

The condenser 23 in the plate circuit of tube 10 affords an easy path for the alternating current produced in the plate circuit of that tube, and the impedance or choke coil 21, while permitting the direct current from the battery to flow through it to supply the plate current, obstructs the flow of the alternating current so as to keep it out of the battery 20. Similarly the condenser 32 provides an easy path for the alternating current in the plate circuit of the tube 11, and the impedance 28 prevents the alternating current from getting into the battery and through its connections into the plate circuit of the tube 10. Furthermore, if any such current from the tube 11 should get past the impedance 28 it would be further impeded by the impedance 21 and thus kept out of the plate circuit of the tube 10. Thus Arnold disclosed a complete filter combination which was capable of meeting the most severe conditions.

Claims 1, 3, 5, 8, 10 and 11 are in suit of which claim 1, quoted in the margin,[1] may be taken as an illustration.

Only one patent is relied upon by petitioner, namely, Arnold 1,129,942.[2] This patent was cited by the Patent Office against the patent in suit[3] and then withdrawn by the Examiner[4] upon it being pointed out by Arnold[5] that his earlier patent relates to the transmission characteristics of vacuum tube circuits and for its pur-

[1] II, 644. "1. In combination, a plurality of vacuum tube repeaters, a common source of space current for said repeaters, the circuit between one of said repeaters and said source comprising series inductance, and a path comprising capacity bridged across said circuit between said source and said repeater."

[2] III, 1453.

[3] II, 954.

[4] II, 959.

[5] II, 956-957.

poses it is immaterial whether power is supplied from a common battery or from separate batteries.[1] Furthermore, the inductance coils 17 in the patent are coupling elements, as petitioner's expert admitted[2] and are in the coupling position in the circuit and not in the filter position where Arnold shows them in the patent in suit. They therefore correspond in function to the inductance coil 29 in the patent in suit and not to the series impedances 21 and 28 with which the invention of the patent in suit is concerned. Being coupling inductances they are located in the alternating current circuit next to the plates of the tubes and the alternating current has to flow through them.[3] It is obviously impossible for inductance coils 17 to act both as coupling means and as filter elements. They are designed to permit alternating current to pass through them which it is the purpose of the impedances 21 and 28 of the patent in suit to prevent. As respondents' expert testified,[4] and as the District Court specifically found[5] the earlier patent discloses no inductance as a filter means. Similarly, the condensers 18 in the earlier patent do not perform the function of the shunt condensers 23 and 32 of the patent in suit. To perform such function in the absence of properly located inductances, they would have to be enormously large condensers with correspondingly low impedances. There is no such disclosure in the patent,

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[1] This creates a strong presumption of validity. As stated by the Circuit Court of Appeals for the Second Circuit in *Ensign Carburetor Co.* v. *Zenith-Detroit Corporation*, 36 F. (2d) 684, 686: "The patent in suit was granted only after a consideration of the principal prior patents which are now referred to as anticipations • • •. Having had this consideration before the patent issued, the usual presumption of validity which accompanies the grant is greatly reinforced."

[2] I, 262.

[3] I, 180-182.

[4] I, 555-556.

[5] III, 1674.

the only reference which is made in the specification to either the inductances or condensers being as follows:[1]

> "• • • An impedance coil 17 is included in bridge of the output circuit of each audion, and in the output circuit of the two audions, 1, 1, condensers 18, 18 are inserted in series with the resistances 14. By such arrangement the several batteries 11 may be largely reduced in voltage."

All that this statement teaches is that the particular bridge arrangement of the inductance 17, condensers 18 and resistance 14 makes it possible to use smaller grid biasing batteries 11 than would otherwise be the case.

Thus it appears that in his earlier patent Arnold showed a battery for supplying plate current to a plurality of tubes but he *did not disclose the arrangement of series inductances and shunt condensers, claimed in the claims in suit*[2] *and which are essential to the best results with a common source of plate current in an amplifier.* Without these filter means, as we have seen, prohibitive distortion is introduced through the path common to the tubes. These means are included in each of the claims in suit, none of which can be read on the disclosure of the earlier patent.

Arnold thus made another important contribution to the art in providing means for supplying, without distortion, plate current to a plurality of three-electrode amplifying tubes from a common source. The prior art discloses nothing pertinent to the claims in suit. Both of the courts below held those claims valid, and no adequate reason has been advanced by petitioner why those holdings should be disturbed.

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[1] III, 1457, ll. 25-34.

[2] I, 554-556.

Conclusion to Part IV.

Petitioner has assumed a heavy burden in seeking to establish the invalidity of the patents here in suit, after they have been found by both of the courts below to embody patentable invention over the prior art and to be valid. Yet petitioner's argument is singularly free from references to the specific findings of the courts below, or to any testimony upon which it relies in its effort to overthrow those findings. Petitioner merely repeats—largely without supporting references to the record—the arguments which it made below, and which both of the lower courts found to be without merit.

As this Court said recently in *Radio Corporation* v. *Radio Engineering Laboratories, Inc.*, 293 U. S. 1, 8:

> "Through all the verbal variances, however, there runs this common core of thought and truth, that one otherwise an infringer who assails the validity of a patent fair upon its face bears a heavy burden of persuasion, and fails unless his evidence has more than a dubious preponderance."

By making broad and meaningless statements in its brief,[1] petitioner strives to minimize the importance of the inventions of the patents in suit. Indeed, petitioner seeks to give the impression that they are merely a group of patents for recent and minor developments in the radio art, made after that art was well developed. It will be clear, we think, from what has been said above and from the opinions of the courts below, that such is not the fact. As we have seen, all of the inventions were made at the very inception of the art, they constitute very important parts

[1] Brief, pages 67, 68.

of the foundation of the art, and were necessary to its later development. The inventions are of "great merit" and have "proven of great aid to mankind", as the court below has said regarding the Lowenstein patent. Petitioner even goes so far as to say:[1]

> "Respondents' present attempt to appropriate monopolies by the mass of patents in this case, which patents differ from each other neither in substance nor disclosure, insofar as they are here pertinent, but the dates of applications for and issuance of which, spread over a period of many years, certainly does not warrant the approval or sanction of this Court."

It is difficult to understand how any one whose business has been based on the use of the inventions of these patents, who has admitted that the inventions are all embodied in its apparatus, who has admitted that the inventions have been widely used and have been commercially successful, and who asserts a license to use the inventions, could make such a statement. As was well stated by the late Judge Coxe in *O'Rourke Engineering Const. Co.* v. *McMullen, et al.*, 160 Fed. 933, 939 (C. C. A. 2):

> "The keynote of all the decisions is the extent of the benefit conferred upon mankind. Where the court has determined that this benefit is valuable and extensive it will, we think, be difficult to find a well considered case where the patent has been overthrown on the ground of non-patentability."

We submit that petitioner has failed utterly to sustain the burden which it has assumed, or even to state a case which should warrant this Court's review of the concurrent findings of the courts below as to the presence of invention in the patents in suit. As noted above, we

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[1] Brief, page 68.

understand the rule to be that such findings will be accepted by this Court unless clear error is shown (*supra*, p. 92). Petitioner has failed to show any error.

The decrees below should be affirmed.

Respectfully submitted,

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IN THE

Supreme Court of the United States

OCTOBER TERM, 1938.

No. 1.

(No. 357, October Term, 1937, on Rehearing)

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC. AND AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

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BRIEF FOR RESPONDENTS.

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Williston on Contracts, 1937 Edition, Volume 5, paragraphs 1642, 1647, pages 4603, 4604, 4605, 4630-4631	49, 50, 51

IN THE

Supreme Court of the United States

OCTOBER TERM, 1938

No. 1.

(No. 357, October Term, 1937, on Rehearing)

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC. and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

Reprint for Use on Rehearing of First Page and Part I of Original

BRIEF FOR RESPONDENTS.

Opinions of the Courts Below.

The opinion of the Circuit Court of Appeals for the Second Circuit is reported in 91 F. (2d) 922. It will be found in this record at Volume III, page 1712.

The opinion of the District Court is reported in 16 F. Supp. 293. In this record it is at Volume III, page 1618.

Jurisdiction.

This case is here on a writ of certiorari to the Circuit Court of Appeals for the Second Circuit under the provisions of United States Code, Title 28, Section 347.

PART I.

Petitioner had no license, implied or otherwise, under the patents in suit.

Petitioner contends that although the amplifiers in controversy embody the inventions of the patents in suit, petitioner's use of them did not infringe those patents because they were purchased by petitioner from American Transformer Company, a licensee under the patents, and therefore, according to petitioner, they carried with them an implied license permitting petitioner to do with them as it chose. A complete answer to this contention is, we believe, that the American Transformer Company's license was a *limited* license, and its sale of the amplifiers to petitioner was *outside of the scope of that license* and therefore an *infringement*, as was known at the time by both parties to the transaction. Accordingly, no rights under the patents were conferred upon petitioner by the sale.

The facts are these. Amplifiers embodying the inventions of the patents here involved are useful in various fields, including the *commercial* field of sound recording and reproducing, which embraces talking picture equipment for theatres, and the *private or home* field which embraces radio broadcast reception, radio amateur reception and radio experimental reception. We designate this latter field by the convenient expression "private or home", because practically all of the radio reception included in that field is of that character. As we have said, respondents, Western Electric Company and Electrical Research Products, Inc., were, at the time in controversy, exclusive licensees under the patents in suit, for the commercial field of sound recording and reproducing[1] and, under that license, were actively engaged in the business of supplying the patented amplifiers to talking picture theatres, etc. American Transformer Company was one of a number of manufacturers who held non-exclusive licenses confined to the manufacture and sale of the pat-

[1] I, 603, 604.

ented amplifiers for *private or home* use, as distinguished from *business or commercial* use.[1] These licenses were granted by Radio Corporation acting for itself and also for respondent, American Telephone and Telegraph Company, and were assented to by the latter.[2]

The American Transformer Company's license was confined by the express terms of the grant, to the right[3]—

> "to manufacture * * *, and to sell [the patented amplifiers] *only* for *radio amateur reception, radio experimental reception, and radio broadcast reception* * * *."[4]

In other words, the Transformer Company had *no right or license to sell the patented amplifiers for use in theatres as part of talking picture equipment, or for any other use not specified in its license.*

Nevertheless, the Transformer Company sold the amplifiers in controversy to petitioner *for that particular commercial use. It did so knowing that they were going to be put to that use.*[5] This is established by the testimony of the Transformer Company's president[6] and its sales agent.[7] Indeed, petitioner *admits* that the Transformer Company *"knew that the amplifiers it sold to petitioner were to be used in the motion picture industry."*[8] Such sales were extensive and recurrent, continuing even after this suit was brought.[9] Furthermore, petitioner, in

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[1] Arrangements of this kind are not at all unusual. It is *stipulated* in this case (I, 585, 586):

> "it is *common practice* where a patented invention is applicable to different uses, to grant written licenses to manufacturers under United States Letters Patents restricted to one or more of the several fields of use permitting the exclusive or non-exclusive use of the invention by the licensee in one field and excluding its use in another field."

[2] III, 1423. [3] III, 1415.

[4] Emphasis ours throughout this brief unless otherwise noted.

[5] I, 341, 383, 408. [7] I, 341.

[6] I, 407, 408. [9] III, 1580, *et seq.*

[8] Original Brief for Petitioner, page 36; see also Brief for Petitioner on Rehearing, page 4.

Hereafter in this Reprint, reference to pages in petitioner's "brief" will refer to pages of the Brief for Petitioner *on Rehearing*. In the few instances where page references are still made to the original Brief for Respondents, that brief will be identified as "Original Brief".

purchasing those amplifiers from the Transformer Company for that use, *had actual knowledge that the Transformer Company had no license to make such a sale, as the record clearly shows,*[1] *and as the District Court specifically found.*[2]

Although the Transformer Company knew that these amplifiers were to be used for the commercial use noted, and although it sold them *outside* of the license, for that particular use, it went through the form of affixing to them the same notice[3] that it customarily affixed to amplifiers sold by it *under* the license, as required by its paragraph 5, *viz.* (III, 1418):

> "License Notice—This Apparatus is Licensed Only for Radio Amateur, Experimental and Broadcast Reception Under the Following Patents of the Radio Corp'n of America and Associated Companies,"

listing the patents. The notice so affixed was a mere pretense and was intended by both the Transformer Company and petitioner to be "disregarded".[4]

The Circuit Court of Appeals found[5]—

> "It was beyond the scope of the American Transformer Company's license to sell the amplifiers for the use

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[1] I, 358, 359. In its letter of November 23, 1928 to petitioner, in reply to the latter's initial request for information and prices (II, 731), the Transformer Company said (II, 732):

> "We have your letter of the 17th in regard to amplifiers to be used *with phonograph and the like in theatres.*
>
> "The license which we have with the Radio Corporation of America is that *the amplifier is to be used for broadcasting reception and for experimental and amateurs use only and not for commercial use.* That is the type of license notice which is placed upon the amplifier and *is the only way which we can sell them.*"

[2] III, 1627 and 1645. At page 1628, the court quotes the above letter in support of its finding.

[3] I, 360, Plaintiffs' Exhibit 30; II, 734.

[4] I, 370.

[5] III, 1724.

for which it sold them to defendants [petitioner]. The sale was therefore an infringement and not a licensee's lawful sale."

After acquiring the amplifiers through this unlicensed, infringing sale, petitioner proceeded to lease them for a large consideration to theatres for use in reproducing talking pictures.[1] It is that act that is here charged as an infringement.

Argument.

In its main argument of non-infringement, petitioner ignores the fact that the sale of the amplifiers by the Transformer Company to petitioner was *outside* of the Transformer Company's license to sell, and treats the situation as if that sale had been *under* the patents in suit (*i. e.*, by the patent owner itself or *under* a license from the patent owner). Upon the erroneous assumption that the sale was *under* those patents, petitioner contends that by that transaction it acquired the unrestricted right to use the amplifiers as it wished, in spite of its admission that it had actual knowledge at the time of sale that they were licensed for private or home use only and not for commercial use. For, says petitioner, a patent owner cannot under any circumstances or in any manner place a restriction, which will be enforceable under the patent law, upon the use to which a purchaser may put a device which has been made and sold under the patent.

We do not agree with this proposition of law. We believe the law to be that reasonable restrictions limiting the field of use of a patented device are enforceable under the patent law against a purchaser with notice. They have never been held otherwise. However, this point is not involved in this case because here, as we have seen, the

[1] I, 65. See the lease, II, 735.

sale to petitioner was not a sale *under* the patents, but a sale *in infringement* of the patents, brought about by petitioner's connivance with the Transformer Company, with full knowledge of all the facts. Therefore, we shall postpone our discussion of petitioner's proposition of law until after we have dealt with the issue actually presented by the facts in this case.

A.

The fact that the amplifiers in question were sold to petitioner by the American Transformer Company, which had a license under the patents in suit, does not excuse petitioner's infringement of those patents because that sale was outside of the Transformer Company's license, as both petitioner and the Transformer Company knew at the time. The Transformer Company's sale was itself an infringement and therefore could not confer upon petitioner any right or license under the patents.

As this Court said in *Bloomer* v. *McQuewan*, 14 How. 539, 549:

> "The franchise which the patent grants, consists altogether in the right to exclude everyone from making, using, or vending the thing patented, without the permission of the patentee. This is all that he obtains by the patent."[1]

A license is a mere permission granted by the patentee—a "mere waiver of his right to sue", *DeForest Radio Telephone Co.* v. *United States*, 273 U. S. 236, 242. If a licensee "performs an act in reference to the licensed invention which his license does not authorize • • • he is guilty of infringement". *Robinson on Patents*, Sec. 916.

[1] See also the full discussion in the *Paper Bag Patent Case*, 210 U. S. 405, 423, *et seq.*

"Any sale beyond the terms of the license is an infringement." *L. E. Waterman Co.* v. *Kline, et al.*, 234 Fed. 891, 893 (C. C. A. 4).

Thus, if the license grants permission to use a patented process for one purpose only, the licensee is liable as an infringer if he uses it for another purpose. *Rubber Co.* v. *Goodyear*, 9 Wall. 788, 799.

Similarly, as was stated by this Court in *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490:

> "* * * The patentee may make and grant a license to another to make and use the patented articles, but withhold his right to sell them. The licensee in such a case acquires an interest in the articles made. He *owns* the material of them and may use them. But if he *sells* them, he infringes the right of the patentee, and may be held for damages and enjoined."

So also, if a license gives the licensee permission to make the patented thing and to sell it only within a particular territory, the licensee would be an infringer if he went into another territory and *there* sold the patented thing. Or, if the license gives the licensee permission to make devices covered by a patent and to sell them "for use only in connection with and as part of" machines of a specified type, the sale of those devices by the licensee as part of machines of a different type is an infringement. *Vulcan Mfg. Co.* v. *Maytag Co.*, 73 F. (2d) 136, 138 (C. C. A. 8).

Similarly where, as here, the license gives the licensee permission to make the patented devices and to sell them only for specified uses, their deliberate sale by the licensee *for an entirely different use*, is an infringement.

There can be no doubt of the correctness of the finding of the Circuit Court of Appeals that the Transformer Company's deliberate and unauthorized sale of amplifiers to petitioner for use in talking picture theatres was "an infringement and not a licensee's lawful sale".[1]

It follows that petitioner, which was fully conversant with all of the facts and which conspired with the Trans-

[1] III, 1724.

former Company in causing it to exceed the bounds of its license, acquired no rights under the patents with regard to those amplifiers by virtue of its purchase of them from the Transformer Company. Petitioner's subsequent leasing of those amplifiers to talking picture theatres was just as much an infringement of those patents as if petitioner had purchased them from someone who had no license at all, or as if petitioner had made them itself. Indeed, in view of petitioner's conspiracy with the Transformer Company in bringing about the infringing sale by that company to it, it is liable for that infringement, jointly with the Transformer Company, as well as for its own subsequent infringing use of the amplifiers.[1]

Petitioner's argument on this point is fallacious:

In its statement of facts,[2] petitioner correctly states that the Transformer Company's license under the patents in suit was a license—

> "'to manufacture * * *, and to sell *only* for radio amateur reception, radio experimental reception, and radio broadcast reception * * *' (Vol. I, pp. 332-335; Vol. III, p. 1415)".

For the reasons just stated, we cannot ignore the limited character of this license to sell, or the fact that the Transformer Company's sale of amplifiers to petitioner was known by both of them to be outside of the scope of that license. In our view, those facts dispose completely of the defense of non-infringement in this case.

Yet petitioner persists in blinking these facts. For example, in its statements of Point I and Point II,[3] concern-

[1] Petitioner refers (Original Brief, p. 41) to the fact that respondents did not also sue the Transformer Company. That was not necessary. Since the Transformer Company and petitioner were both infringers, jointly and severally, either or both could be sued. Respondents chose to sue petitioner which was in direct competition with the business of the licensed respondents in their exclusive field.

[2] Brief, page 2. [3] Brief, pages 10 and 19.

ing the alleged effect of the sale of a patented article which has been made "under the patent", petitioner avoids saying whether the sale it is talking about was made "*under* the patent", or *in infringement* of the patent, as in this case.

Similarly, in its heading on page 11, it speaks of the sale of a patented article by a licensee having "*a* power of sale", but avoids saying whether the sale to which it is referring is within the licensee's power of sale, or is outside of it, as in this case. And in supposed connection with our position that the sale of the amplifiers to petitioner, being outside of its vendor's power of sale, carried with it no rights under the patents in suit, petitioner says:[1]

> "In the first place the fact that the licensee undeniedly had the right to *sell* is a complete answer." (Emphasis is petitioner's).

That is no answer at all because it is untrue with respect to the sale to petitioner. The whole point is that *the vendor had no right to make this particular sale, as both it and petitioner knew.*

The situation is no different from that which might arise in the case of a licensee who had a license to sell only five machines. If such a licensee, after selling the five machines under his license, sold another one to a person who knew of the limitation of the license and that the license was being exceeded, that sale and the purchaser's subsequent use of the machine, would be infringements. As already noted, "any sale beyond the terms of the license is an infringement". *L. E. Waterman Co.* v. *Kline, et al.*, 234 Fed. 891, 893.[2] And an infringing sale carries with it no rights under the patent.

Petitioner also seeks to get some comfort out of its assertion that[3] "to each amplifier made and sold by it to petitioner, there was attached a 'license notice' precisely as set forth in its license agreement with respondents".

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[1] Brief, page 32.

[2] *Supra*, page 13.

[3] Original Brief, page 34.

So far as the present point is concerned, the fact that "license notices" were attached to the amplifiers is of no moment whatever. The Transformer Company's license agreement provided:[1]

> "5. The Licensee shall affix to all Licensed Apparatus manufactured and *sold by the Licensee under the terms of this Agreement*, a license plate reading:
>
> "'Licensed only for Radio Amateur, Experimental and Broadcast Reception' * * *."

But petitioner's amplifiers were *not* "sold by the Licensee under the terms of this Agreement". They were sold *outside* of the terms of the agreement. It did no good for the Transformer Company to *pretend* that they were sold under the terms of the agreement by attaching to them the "license notice" required by the agreement for licensed sales.

Nor does the following assertion by petitioner advance its argument in the slightest:[2]

> "* * * If the licensee, in exercising his right to sell, is claimed to have breached some express covenant in his license agreement, the remedy—and the only remedy—of the licensor lay in *a suit against the licensee because of the breach.* No cause of action—and certainly not one under the patent law—would lie against the purchaser." (Emphasis petitioner's.)

We are not relying here on any breach of covenant by the Transformer Company. Our claim is that in selling the patented amplifiers to the petitioner for use in talking picture equipment for theatres, that company made a sale which the patent owner had not granted it permission to make, and which was therefore an infringement. Accordingly, the fact that petitioner acquired the amplifiers by virtue of that sale affords no defense to the charge of infringement in this case against petitioner for its own infringing use of the amplifiers.

Petitioner refers to the lower court decision in *Mitchell v. Hawley*, 11 Fed. Cas. 883, 885 (Case No. 6250).[3] In that

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[1] III, 1418, paragraph 5.

[2] Brief, page 32.

[3] Brief, pages 32, 33.

case the court was considering the question of whether the purchaser of a patented machine was liable as an infringer for using the machine during the extended term of the patent.[1] It held that he was, since his vendor was a licensee under a restricted license which "expressly provided that he shall not, in any way or form, dispose of any license to use the machines beyond the third day of May, 1867", that being the date of expiration of the original term of the patent, and "he clearly could not convey any greater rights than he possessed". The decision of the Circuit Court was affirmed by this Court (*Mitchell* v. *Hawley*, 16 Wall. 544). Instead of support-

[1] The term of the patent had been extended under the provisions of Sec. 18 of the Patent Act of 1836 (5 Stat. at large 117) then in force, which read:

> "Section 18. *And be it further enacted.* That whenever any patentee of an invention or discovery shall desire an extension of his patent beyond the term of its limitation, he may make application therefor, in writing, to the Commissioner of the Patent Office, setting forth the grounds thereof; * * *. And if, upon a hearing of the matter, it shall appear to the full and entire satisfaction of said board, having due regard to the public interest therein, that it is just and proper that the term of the patent should be extended, by reason of the patentee, without neglect or fault on his part, having failed to obtain, from the use and sale of his invention, a reasonable remuneration for the time, ingenuity, and expense bestowed upon the same, and the introduction thereof into use, it shall be the duty of the Commissioner to renew and extend the patent, by making a certificate thereon of such extension, for the term of seven years from and after the expiration of the first term; * * * and thereupon the said patent shall have the same effect in law as though it had been originally granted for the term of twenty-one years. *And the benefit of such renewal shall extend to assignees and grantees of the right to use the thing patented, to the extent of their respective interests therein* [Italics ours]: *Provided however* [Italics in original], That no extension of a patent shall be granted after the expiration of the term for which it was originally issued."

ing petitioner's argument the case is clear authority against it, as was held by both of the courts below.[1]

Petitioner's fragmentary quotation from the lower court's decision in that case,[2] tends to convey exactly the opposite meaning from that intended by the court. In that portion of its opinion the court was drawing a contrast between the situation as it actually existed, with the vendor a restricted licensee, and the situation which would have existed if the vendor had been "a territorial *assignee*" of the original patent, *i. e.*, the *owner* of that patent for a given territory. Being only a restricted licensee, the court said (p. 885):

> "He had no power to sell a machine so as to take it out of the monopoly of the patent."

But, the court continued—and in this quotation we have italicised the words for which petitioner substituted asterisks—

> "Had he *been a territorial assignee and* possessed the power to sell the patented machines, the purchaser would have acquired a title which would have been outside of the monopoly, and would have acquired the absolute right to use the machines during the extended term; and this notwithstanding any covenants Bayley might have made not to convey such a title. Under such circumstances, the patentee must have sought his remedy against Bayley on his covenants."

Under these circumstances, the patentee would have had to pursue his remedy against the vendor on his covenants because a territorial *assignee*, being the owner of the patent for that territory and having, therefore, an absolute right to sell the patented machines in that territory, could not have *infringed* the patent by any sale made *within* that territory, no matter how unrestricted the sale might have been.

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[1] III, 1724, 1630. And see our further discussion of the case, *infra*, pages 29, 38-42.

[2] Brief, pages 32, 33.

But that has no bearing on this case, where petitioner's vendor was not a territorial assignee under the patent, but only the holder of a limited license, and where its sale to petitioner was outside of its license and therefore an infringement. There can be no valid excuse for petitioner's omission of the essential words from the above quotation.

The cases of *Adams* v. *Burke*, 84 U. S. (17 Wall.) 453, *Hobbie* v. *Jennison*, 149 U. S. 355, and *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, cited at page 35 of petitioner's brief, emphasize still further the difference between a territorial assignee and the holder of a limited license to sell. In each of those cases the vendor was a territorial *assignee* of the patent, and had made an *absolute and unrestricted sale of the patented device within his own territory, as he had a perfect right to do, in view of his ownership of the patent for that territory.*[1] In the first and last of these cases the defendants (alleged infringers) were the persons who had purchased the patented devices from the territorial assignees by sales of that character, and had then proceeded to use or sell them outside of their vendor's territory. In the second of these cases (*Hobbie* v. *Jennison*), the suit was against the territorial assignee himself, who had made an absolute sale of patented articles in his territory, with knowledge that they were to be used elsewhere by the purchaser. In each case it was held that there had been no infringement. In making the *unrestricted* sale, *within* his territory, the territorial assignee had done only what he had a right to do under the patent. The patented articles had been "lawfully made and *sold*",[2] *i. e.*, sold *under* the patent because sold *within* the territory covered by the assignment.

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[1] At pages 34, 35 of its brief petitioner misconstrues these cases in assuming that the vendor's "right to sell" was restricted.

[2] *Adams* v. *Burke*, 17 Wall. 453, 457; *Hobbie* v. *Jennison*, 149 U. S. 355, 363.

The distinction between these cases and the present one is clear. For, as we have said, the vendor in the present case was not an assignee of the patents, territorial or otherwise, but only the holder of a limited license under them; and its sale to petitioner, instead of being a "lawful" sale, was beyond the terms of its license and therefore "an infringement and not a licensee's lawful sale".[1]

Neither the case of *Straus* v. *Victor*, 243 U. S. 490, nor the *Motion Picture Patents* case, 243 U. S. 502, both of which are cited at pages 35, 36 of petitioner's brief, has any bearing upon the present question.

The first of these cases stands for the proposition that the patent law does not give a patent owner the right to fix the resale price of his patented article, the second, that it does not give him the right to compel the purchaser of a patented machine sold under a patent, to use it only with *unpatented* supplies purchased from the patent owner. They are discussed more in detail later.[2]

The license of American Transformer Company affords no defense to the charge of infringement against petitioner in this case. For the Transformer Company's sale to petitioner was not *under* that license, but *outside* of it, as both of them knew. Therefore, that sale and petitioner's subsequent use of the amplifiers, were just as clearly *infringements* of the patents, as if the vendor had had no license at all.

We come now to our discussion of the contention made by petitioner in its Points I and II.

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[1] Opinion of Circuit Court of Appeals in this case (III, 1724).

[2] *Infra*, pages 33, 36, 46.

B.

Reasonable restrictions of the character here involved, which limit the field of use of a patented device sold under the patent, are valid and enforceable under the patent law as against one who has purchased the device with knowledge of the restrictions. Therefore petitioner would have been an infringer even if the sale of the amplifiers to it had been *under* the patents in suit instead of *in infringement* of those patents.

This point of law would become germane to this case only if this Court should find that the sale of the amplifiers to petitioner was within the terms of the vendor's license. As we have already pointed out, the record shows that it was not, and the court below so found. Therefore, the point is moot. Our discussion of it, as in the Courts below, is by way of replying completely to petitioner's brief, which we feel compelled to do. This discussion will necessarily be of some length because of the nature of the point. *For the purpose of this discussion, and solely for this purpose, we shall disregard the fact—which itself disposes completely of the defense of non-infringement—that the sale of the amplifiers to petitioner was in infringement of the patents.*

In order to overcome the charge of infringement in this case, petitioner must show affirmatively that it had a license to use the amplifiers in question, in the field in which it used them, namely, in the commercial field of talking motion picture reproduction in theatres. For, as we have seen, petitioner admits that those amplifiers embody the inventions claimed in the patents in suit.[1] Peti-

[1] License is an affirmative defense to be established by the party asserting it. *Sherman, Clay & Co.* vs. *Searchlight Horn Co.*, 225 Fed. 497, 500; *Union Special Mach. Co.* vs. *Maimin*, 185 Fed. 120, 128.

tioner does not contend that it ever received an express license to use them in that field. On the contrary, at the trial petitioner's counsel stated that the amplifiers were sold to petitioner with the limited license to use them only for radio amateur, experimental, and broadcast reception. In this connection counsel said:[1]

> "• • • The apparatus was sold to us with that limited license of use, in accordance with the express terms of the American Transformer license, noticed right on the instrument itself."

Nevertheless, petitioner seeks to establish that it was licensed to use these amplifiers for the commercial reproduction of talking pictures in theatres, by contending that from a legal standpoint, the limitations of that express license were void *ab initio*, and that therefore petitioner acquired with the amplifiers an unlimited license to use them in any and all fields.

In support of this contention petitioner argues that the sale of a patented device under the patent, automatically and inevitably conveys to the purchaser, by implication, an unrestricted license to do what he will with the thing purchased, and that it is impossible for the patentee to overcome that implication even by a notice of the restrictions brought home to the purchaser at the time of the purchase. According to petitioner, the sale "exhausts the monopoly of the patent owner as to the particular article involved",[2] irrespective of any precautions that may be taken to avoid this result. In this connection, petitioner quotes general language from decisions by this Court about the sale of a patented article taking it out of the patent monopoly.

Later[3] we shall discuss these decisions and point out that the language which petitioner quotes from them had its origin in cases which did not involve restricted sales of patented articles, and that it should be un-

[1] I, 325.

[2] Brief, page 13.

[3] *Infra*, pages 37-49.

derstood as applying only to unrestricted sales. The only instances in which this Court has held restrictions imposed in connection with the sale of a patented device to be invalid are (1) where the restrictions sought to fix the resale price of the device, and (2) where they sought to compel the purchaser of the device to purchase from the patentee *unpatented* supplies required in the operation of the patented device. These restrictions were held invalid as against public policy—those of the first class because it was deemed undue restraint of trade to allow the vendor of an article, whether patented or unpatented, to dictate resale prices, and those of the second class because they attempt to include within the scope of the patent monopoly, materials which are not covered by the patent.

Reasonable restrictions limiting the field of use of a patented device, such, for example, as the one in which we are interested in this case, do not fall within either of these classes and, as petitioner appears to concede,[1] *have never been held invalid.* They are not against public policy, or outside of the scope of the patent monopoly. In our view they are valid and enforceable against a purchaser with notice.

Public policy is not opposed to, and on the contrary distinctly requires, the enforcement of reasonable restrictions on the field of use of a patented device:

Restrictions of this character are beneficial to the public because they promote the purposes of the patent laws, make for fair dealing between the patentee and the public, and stimulate trade and the development of the arts. Frequently, as in this case, the value derivable from the commercial *use* of the patented device far outweighs the intrinsic value of the thing itself. Reasonable restric-

[1] Original Brief, page 10. There petitioner refers to the decisions of this Court merely as being "on closely *analogous* questions", and, on page 39, of Original Brief, to the "*trend* of the decisions of this Court". On page 26 of Brief, petitioner admits a distinction "in the *character* of the restrictions" involved, between the case at bar and this Court's decisions in the above two classes of cases.

tions limiting the field in which such devices may be used, make it possible for a patentee to sell them to the general public at reasonable prices, for use in other fields, while still retaining his exclusive rights in the particular commercial field in which he himself is using the invention.

Were it not possible for him to do this, he would have to elect between two alternatives. He would either have to increase his selling price to the public to an extent sufficient to compensate him for any resultant loss that he might suffer in his own field of use, or he would have to exercise to a greater degree the right of exclusion granted by his patent, and refrain from making or permitting *any* distribution of the patented devices to the general public, as he would have a perfect right to do.[1]

Neither of these alternatives would be advantageous to the public. The extra price which it would be necessary for the patentee to exact from every purchaser, under the first alternative, would, in many cases, be a payment for something that the purchaser did not want, since the purchaser would have no desire to use the patented device in the patentee's field. And under the second alternative, the general public would not be permitted to enjoy the invention until the expiration of the patent monopoly.

If, on the other hand, as we believe to be the case, reasonable restrictions limiting the field of use of a patented device are enforceable under the patent law, the public may acquire such devices freely, and *by paying only for what they want.* For example, a radio enthusiast may buy a patented amplifier for use in his home by paying a price which the patentee is willing to accept for such a sale, and without being required to pay for the privilege (which he does not want) of using it for commercial purposes. In our view it is far more important that the interests of the public generally should be served by making possible restricted sales of this kind, than it is to permit someone like this petitioner to acquire a patented amplifier at a price and under a license, which con-

[1] Paper Bag Patent Case, 210 U. S. 405, 425, *infra*, page 57.

template that it will be used only in the home, and then to use it in the field in which the patentee himself is commercializing the invention.

The view which we advocate is fair to the inventor and the public alike; it encourages and promotes trade, and it provides the incentive to invention and to the investment required for the development of inventions, which it was the object of the patent laws to create.

The authorities sustain the enforceability of express restrictions of the character here involved:

We agree fully with the proposition that an authorized sale of a patented device, made *without notice of any restriction*, gives to the purchaser an implied license to do with it as he will. To use petitioner's language, such a sale indeed "exhausts the monopoly of the patent owner as to the particular article involved". But when the sale is made with knowledge of a restriction limiting the field of use of the device, or other *reasonable restrictions actually within the scope of the patent monopoly*, the usual unrestricted license is replaced by an express restricted license. And if, thereafter, the purchaser exceeds the bounds of that restricted license, he is liable as an infringer.

Preliminary to our discussion of the authorities relating directly to the validity of these restrictions, we call attention to the following statement from *Bement* v. *National Harrow Co.*, 186 U. S. 70, 91 (the decision in which was reaffirmed in *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490):

> "• • • Notwithstanding these exceptions, the general rule is absolute freedom in the use or sale of rights under the patent laws of the United States. The very object of these laws is monopoly, and the rule is, with few exceptions, that any conditions which are *not in their very nature illegal* with regard to this kind of property, imposed by the patentee and agreed to by the licensee for the right to manufacture or use or sell the article, will be upheld by the courts."

It is from this point of view that the question of law now under discussion, should be considered. Unless the

restriction is in its "very nature illegal" it "will be upheld by the courts". As we shall see, this rule has been consistently followed by the courts and under it restrictions upon the use of the patented thing itself, have always been upheld.

The General Rule as Stated by the Authorities:

The true rule, as we have outlined it above, is well expressed in *Robinson on Patents*,[1] Sec. 824, as follows:

> "There are certain cases in which the law implies a license from the dealings of the parties with each other, or from the relations which subsist between them. The most frequent and important of these cases arises when a patented article is sold by anyone who has a right to sell it. From such a sale the law implies a license to the purchaser, and to every subsequent owner of the article, to use it as long as its identity can be preserved. This implied license rests upon the principle that the owner of the patented invention, having once received his recompense for releasing the article from the monopoly, either in its price directly paid to him or in the license-fee which he collects from its vendor, he can thereafter neither limit nor demand compensation for its use, but by the sale delivers it from all the restrictions of the patent and makes it common property like any other personal estate. To have that effect, however, the sale must be a lawful and unconditional sale. * * * *Not only may the patentee impose conditions, limiting the use of the patented article, upon his grantees and express licensees, but any person having the right to sell may at the time of sale restrict the use of his vendee within specific boundaries of time or place or method, and these will then become the measure of the implied license arising from the sale.* But when the sale is unconditional, as is the case in ordinary sales by authorized vendors in open market, the implied license gives to the purchaser and his vendees the unrestricted

[1] Robinson has been recognized for years as the greatest and most authoritative work on Patents and has been cited repeatedly by this Court. For example, Robinson is cited in *DeForest* v. *United States*, 273 U. S. 236, 242, on the subject of license.

right to use the article unless such use infringes some other patent than the one by which the article itself has been protected."

As Judge Wallace put it in *Holiday* v. *Mattheson*, 24 Fed. 185, 186 (C. C. S. D. N. Y.):

> "* * * When the owner of a patent sells the patented article under circumstances which imply that the purchaser is not to acquire an unqualified property in the thing purchased, *as where a license accompanies the transfer*, the purchaser's rights are limited to the extent of the monopoly granted to him."

In *Dickerson* v. *Tinling*, 84 Fed. 192 (C. C. A. 8), a patentee, who owned both United States and foreign patents for a certain drug, had sold the patented drug in Germany to the defendant. Notice that the drug was not to be imported into or resold within the United States, appeared upon the packages containing the drug. The defendant was held liable as an infringer having resold the drug in the United States. The court stated the rule as follows (p. 195):

> "* * * there can be no doubt that a patentee has the same right and power to sell the patented article upon conditions or with restrictions that he has to sell it at all. * * * If the corporation sold the patented article subject to such a restriction, the purchasers, with a notice of this limitation, whether immediate or remote, could acquire no better right than strangers to infringe upon the monopoly secured by the patent."

In *Dickerson* v. *Matheson, et al.*, 57 Fed. 524 (C. C. A. 2), the same ruling had previously been made upon a similar state of facts.

The Court of Appeals for the Second Circuit in *General Electric Co.* v. *Continental Lamp Works*, 280 Fed. 846 (a case decided long after this Court's decisions upon which petitioner relies, *infra*, p. 37), held that the sale by the plaintiff of bases for electric lamps did not carry with it a license under the plaintiff's lamp patents, in view of notice to that effect brought home to the purchaser at the time of his purchase. The court said (p. 851):

> "Use of an invention can only be obtained on the inventor's terms. Without paying or doing what-

ever he exacts; no one can be exempt from his right to exclude, and, whatever the terms, the courts will enforce them, provided only that the licensee is not thereby required to violate some law outside of the patent law. • • •

"So, where the owner of a patent sells a patented article subject to a restriction, the purchasers, with notice of this limitation, could acquire no better right than strangers to infringe upon that part or claim of the monopoly still secured to the patentee" (citing *Dickerson* v. *Tinling, supra*).

The same rule obtains in England. Thus it is said in *Terrell on Patents*, 8th Edition, 1934, the leading English textbook authority (p. 273):

"A purchaser of patented goods without notice of restrictions affecting such goods is free to use and sell them in any way he chooses,[1] but if he has such notice at the time of his purchase and contravenes such restrictions he is liable to be sued for infringement by the patentee, as the restrictions are *'not contractual but are incident to and a limitation of the grant of the license to use*, so that, if the conditions are broken, there is no grant at all'.[2]

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[1] Citing *Betts* v. *Willmott*, L. R. 6 Ch. App. 239, at p. 245; *Incandescent Gas Light Co., Ltd.* v. *Cantelo*, 12 R. P. C. 262; *Incandescent Gas Light Co., Ltd.*, v. *Brogden*, 16 R. P. C. 179; *Scottish Vacuum Cleaner Co., Ltd.* v. *Provincial Cinematograph Theatres, Ltd.*, 32 R. P. C. 353 (O. H.).

[2] Citing Farwell, *J.*, in *British Mutoscope & Biograph Co., Ltd.* v. *Homer*, 18 R. P. C. 177, at p. 179; see also *National Phonograph Co. of Australia, Ltd.* v. *Menck*, 28 R. P. C. 229 (P. C.) at p. 248; see also *Columbia Phonograph Co. General* v. *Regent Fittings Co.*, 30 R. P. C. 484; *Columbia Graphophone Co.* v. *Vanner*, 33 R. P. C. 104; *Columbia Graphophone Co., Ltd.* v. *Murray*, 39 R. P. C. 239; *Columbia Graphophone Co., Ltd.* v. *Thoms*, 41 R. P. C. 294.

The English case of *Taddy* v. *Sterious*, L. R. (1904) 1 Ch., 354, cited on page 33 of petitioner's brief, related to a resale price restriction on *unpatented* articles. The above cases in this footnote, cited by Terrell, are the controlling English cases enforcing restrictions on *patented* articles after sale.

"The question of the knowledge of the defendant is one of fact in each case, as to which the passing of some leaflet or label with the goods at the time of sale may or may not be sufficient evidence according to the nature of the goods and the general circumstances. It is not essential that the purchaser should have knowledge of the precise restrictions concerned so long as he has knowledge of their nature and existence and means of knowledge of their exact extent."[1]

Decisions Applying the Rule to Restrictions upon the Use of the Patented Device Itself:

In every case with which we are familiar where it has been necessary to pass upon *restrictions upon the use of the patented device itself,* the rule stated in the above quotations has been followed, and the restrictions held valid and enforceable under the patent law.

The only case in which this Court has been required to pass directly upon restrictions of this character is *Mitchell* v. *Hawley,* 16 Wall. 544, previously referred to.[2] The restriction there in question limited the time during which the patented machines could be used. It permitted their use only during the original term of the patent. The defendant had purchased the machines from a licensee *whose license did not permit him to grant the right to use them beyond that term.* The purchaser was held *chargeable with knowledge* of the limited character of his vendee's rights. The patent term was extended under the provisions of the Patent Statute then in force.[3] The purchaser continued to use the machines after the expiration of the original term. *This Court held that such use exceeded the right to use, acquired by the purchaser, and was an infringement.* It was argued in that case (p. 546) that

[1] Citing *Columbia Graphophone Co., Ltd.* v. *Murray,* 39 R. P. C. 239; cf. *Badische Analin und Soda Fabrik* v. *Isler,* 23 R. P. C. 633 (C. A.).

[2] *Supra,* pages 16-19.

[3] Quoted, *supra,* page 17.

the sale "operated to take *the thing sold* out of the reach of the Patent Act altogether, and that as long as the machines themselves lasted, the owner could use them"—the same argument that is urged upon the Court in the present case. The Court decided against the defendant, nevertheless, for the reasons stated above. And the Court, distinguishing *Bloomer* v. *McQuewan*, 14 How. 549, here relied upon by petitioner, made clear its recognition of the rule that a sale made "without any conditions" would have had the effect for which the defendant was contending.[1]

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[1] The Court said, page 547:

> "• • • a patentee, when he has himself constructed a machine and sold it *without any conditions*, or authorized another to construct, sell, and deliver it, or to construct and use and operate it, *without any conditions*, and the consideration has been paid to him for the thing patented, the rule is well established that the patentee must be understood to have parted to that extent with all his exclusive right, and that he ceases to have any interest whatever in the patented machine so sold and delivered or authorized to be constructed and operated";

also, that the purchaser of a machine *under such circumstances*

> "may continue to use it until it is worn out, in spite of any and every extension subsequently obtained by the patentee or his assigns."

And, the Court cites in this connection *Bloomer* v. *McQuewan*, 14 How. 549, and *Chaffee* v. *Boston Belting Co.*, 22 How. 223, cases which so hold. But the Court said further (p. 548), that

> "*Sales* of the kind may be made by the patentee *with or without conditions* • • •",

and, since, in the case before the Court, the right granted to the maker of the machines had been expressly limited by the license contract so that he could not license the use of them beyond the expiration of the original patent, the Court enjoined as an infringement, the further use of the machines.

Continuation of Footnote on Page 30, this continuation being new, and not a reprint of anything heretofore filed.

In the Reply Brief for Petitioner on the prior hearing (pp. 9, 10), our treatment of the decision of this Court in *Mitchell* v. *Hawley* is criticised on the ground that the lower court in that case said that Bayley, the manufacturer of the machines involved, had no authority from the patent owner "to give any title to the machines" to another.

We do not believe that our treatment of this Court's decision in that case is subject to criticism on that score.

The facts were that Bayley had (p. 545)—

> "the exclusive right to *make* and use, and to license to others the right to *use* the said machines"

in the territory in question. This was subject, however, to the proviso (*id.*)—

> "that the said Bayley shall not in any way or form dispose of, sell, or grant any license to use the said machines beyond the 3rd day of May, A. D. 1867."

Since Bayley was the only one licensed to *make* the machines, his right "to license to others the right to *use*" them would have been futile were it not for the necessary implication that those who obtained from him the right to *use* the machines could also obtain from him the machines to be used. So, as this Court said (p. 549):

> "• • • Bayley, *as such licensee,* on the eighteenth of March, 1864, constructed four machines, being two sets, and *sold* the machines, 'with the right to run' the same, to the grantors of the respondents, for the sum of twelve hundred dollars, executing to the purchasers at the same time a license under his hand and seal, authorizing the purchasers, as such licensees, 'to run and use two sets (four machines) for felting hats, in said Town of Haverhill, under Taylor's patent, bearing date as specified in the original letters-patent,' showing conclusively that the purchasers were referred to the original letters-patent as the source of his authority."

There is no suggestion in the Court's opinion that Bayley who, as just stated, unquestionably had the right to *furnish* patented machines to the prospective user, had

no right to do so by way of sale, which transferred title. That Bayley did so in that way is clear from the opinion, and the Court does not criticise that form of transfer. The Court's point was that Bayley (p. 551)—

> "never had any power to sell a machine so as to withdraw it *indefinitely* from the operation of the franchise secured by the patent".

That is, he had no right to sell a patented machine otherwise than subject to a restriction limiting its use definitely to the term of the original patent. The purchaser, who had knowledge of, or was chargeable with knowledge of, that fact, purchased subject to that restriction. His later use of the machines in violation of that restriction was held to be an infringement.

This decision has never been overruled by this Court. It has been cited frequently by this Court, and has been followed in many decisions of the lower courts, for example, in *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536 (C. C., D. Mass., Lowell, *J.*) in which another restriction upon the duration of the permitted use was upheld. In that case, the court construed the document before it as a sale of certain patented machines conditioned upon payment of royalty up to a certain date, without the right to use the machines thereafter unless some further agreement should be made. After the stipulated period had expired, no new agreement having been made, the court enjoined the use of the machines and said (p. 537):

> "We agree that the words, 'the said seven machines are valued at $800, the receipt of which is acknowledged,' import a sale of the machines; and that an absolute and unqualified sale of a patented machine carries with it the right of use. But the mere value of a patented machine is often, and is proved to be in this case, insignificant in comparison with the value of its use; and the courts have permitted a severance of ownership and right of use, if the patentee has chosen to dissever them, and if his intent is not doubtful. For instance: a license to use a machine implies the right to make and own it; and yet, if the owner neglects to pay the license fee, he may be restrained from using a machine to which his title is undoubted. One who is licensed to make, use, and sell machines for the term of the patent, and no longer, sells a machine with the right to use it. The purchaser owns the machine, but if the patent is extended, he has no right to use it, during the extended term, without a further license from the patentee. *Mitchell* v. *Hawley*, 16 Wall. 544. In many other cases the ownership of the machine will not necessarily carry with it the right to use it without the permission of the patentee."

In *Skee Ball Co.* v. *Cohen*, 286 Fed. 275 (D. C. E. D. N. Y.), a case decided long after the decisions of this

Court that are relied upon by petitioner, the court upheld a restriction imposed at the time of sale, limiting the use of the patented skee ball alley, to a prescribed area. The purpose of the restriction was to prevent destructive competition between licensees.

Decisions of this Court Establishing Exceptions to the General Rule:

As we have previously stated, only two specific exceptions have been established to the general rule as to the enforceability of restrictions brought home to the purchaser at the time of his purchase of a patented device. They are (1) restrictions attempting to fix the resale price, and (2) restrictions seeking to compel the purchaser to purchase unpatented supplies from a specified source.

(1) *Restrictions fixing the Resale Price:*

The case which established this exception to the general rule, with regard to patented articles is *Bauer* v. *O'Donnell,* 229 U. S. 1 (The "*Samatogen*" case), in which the maker of a patent medicine attempted, by notice appearing upon the containers, to fix the price at which retailers purchasing it from him or from his dealers might sell it. In *Bobbs-Merrill Co.* v. *Straus,* 210 U. S. 339, the Court had held that restrictions fixing the resale price of copyrighted books could not be enforced under the copyright laws. In the *Bauer* v. *O'Donnell* case, it applied the same doctrine to the patent laws. The Court said (pp. 11, 12):

> "The object of the notice is said to be to effectually maintain prices and to prevent ruinous competition by the cutting of prices in sales of the patented article. That such purpose could not be accomplished by agreements concerning articles not protected by the patent monopoly was settled by this court in

> the case of *Dr. Miles Medical Co.* v. *Park & Sons Co.*, 220 U. S. 373, in which it was held that an attempt to thus fix the price of an article of general use would be against public policy and void. It was doubtless within the power of Congress to confer such right of restriction upon a patentee. Has it done so?"

Then, after discussing the patent statute (and comparing it with the copyright statutes), the Court concluded that it must answer this question in the negative.

Thus the holding of *Bauer* v. *O'Donnell* is merely that there is nothing in the patent law that can save an attempt to fix resale prices of patented articles from the rule of public policy applicable to such attempts in the case of unpatented articles.

This doctrine was reaffirmed in *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490,[1] and *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8. It is not applicable in any way to the present case.

(2) *Restrictions relating to Unpatented Supplies to be Used with a Patented Machine:*

The decision which established this exception is *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502. It specifically overruled *Henry* v. *Dick*, 224 U. S. 1, which had held that the general rule to which we have referred was applicable even to restrictions which apply not to the use of the machine that is covered by the patent, but to supplies not covered by that patent.

In this *Motion Picture* case a motion picture machine was sold by a licensee of the plaintiff (patent owner) with a notice that it could be used only with films leased from licensees of the plaintiff and containing the invention

[1] In *Straus* v. *Victor Talking Machine Co.* an attempt had been made to avoid the principle announced in *Bauer* v. *O'Donnell* by cloaking what was really a sale in terms indicating a mere license to use; but the Court looked through this disguise and treated the transaction as what it really was, a sale.

covered by another of plaintiff's patents (which had expired). The specific question considered by this Court was (p. 508):

> "May a patentee or his assignee license another to manufacture and sell a patented machine and by a mere notice attached to it limit its use by the purchaser or by the purchaser's lessee, to films *which are no part of the patented machine, and which are not patented?*"

In answering this question in the negative, the Court placed its decision squarely on the ground that the patent law does not grant any monopoly *except a monopoly of the invention which the claims of the patent cover,* and that to allow a patentee, by such a restriction as to the use of supplies with his patented machine, to extend his monopoly to include articles not covered by the patent, is an unjustified restraint of trade and against public policy.

Thus the Court said (p. 518):

> "Such a restriction is invalid *because such a film is obviously not any part of the invention of the patent in suit;* because it is an attempt, without statutory warrant, to continue the patent monopoly in this particular character of film after it has expired, and because to enforce it would be to create a monopoly in the manufacture and use of moving picture films, *wholly outside of the patent in suit and of the patent law as we have interpreted it.*"

This statement alone makes it clear that the Court was confining its condemnation to restrictions of the character there before it, and that it had no intention of condemning restrictions, such as those here involved, upon the use of the patented machine itself. At other points in the opinion, this distinction is brought out even more forcibly. For example, at page 512, after referring to R. S. § 4884 which provides that every patent "shall contain • • • a grant to the patentee, his heirs or assigns • • • of

the exclusive right to * * * use * * * the invention or discovery", the Court said:

> "Plainly, this language of the statute and the established rules to which we have referred restrict the patent granted on a machine, such as we have in this case, to the mechanism described in the patent as necessary to produce the described results. It is not concerned with and has nothing to do with the materials with which or on which the machines operates. The grant is of the exclusive right to use the mechanism to produce the result with any appropriate material, and the materials with which the machine is operated are no part of the patented machine or of the combination which produces the patented result. *The difference is clear and vital between the exclusive right to use the machine which the law gives to the inventor and the right to use it exclusively with prescribed materials to which such a license notice as we have here seeks to restrict it.* The restrictions of the law relate to the useful and novel features of the machine which are described in the claims of the patent, they have nothing to do with the materials used in the operation of the machine; while the notice restrictions have nothing to do with the invention which is patented but relate wholly to the materials to be used with it. Both in form and in substance the notice attempts a restriction upon the use of the supplies only and it cannot with any regard to propriety in the use of language be termed *a restriction upon the use of the machine itself.*"

It seems obvious that if this Court in its earlier decision in *Bauer* v. *O'Donnell*, 229 U. S. 1, *supra*, (holding resale price restrictions invalid) had meant to hold, as petitioner implies, that *all* restrictions accompanying the sale of a patented device were invalid, it would not have placed this *Motion Picture* decision on the ground that the particular restrictions before it were restrictions "upon the use of supplies only" and not "upon the use of the machine itself." A mere statement of the broad proposition for which petitioner now contends would have sufficed. The great care

that this Court took in this decision to distinguish between these two different kinds of restrictions, indicates definitely that neither the *Bauer* v. *O'Donnell* decision nor this one, was intended to change the general rule as to the enforceability of restrictions such as we have in the case at bar, which are actually "upon the use of the machine itself" and therefore *clearly within the patent monopoly.*

The *Motion Picture* case, and also the more recent *Carbice* case (*Carbice Corp.* v. *American Corp.*, 283 U. S. 27, and on rehearing page 420[1]), by drawing a sharp distinction between restrictions on the use of unpatented supplies and restrictions relating to the use of the patented machine itself, constitute a most persuasive argument for the validity of the restriction here involved and are in accord with the authorities upon which we rely.

The restriction in the instant case comes under the general rule and is enforceable:

The restriction involved in this case, limiting the field in which the patented amplifiers may be used, is a restriction *upon the use of the patented machine itself.* Therefore, it falls within the general rule and is enforceable under the patent law.

Independent Wireless Telegraph Co., et al. v. *Radio Corp. of America, et al.*, 269 U. S. 459, which came here on a question of joinder of parties, is of interest on this point. The defendant had purchased patented vacuum

[1] Petitioner merely cites (Brief, p. 25) the *Carbice* case as being to the "same effect" as the *Motion Picture* case. In the opinion on rehearing in the *Carbice* case this Court stated (p. 421) that in the first decision "we held that the bill should be dismissed on the ground that the owner of a patent may not limit its use so as to require that *unpatented* materials employed in practicing the invention shall be purchased from the licensor * * *". See also pages 31 to 33 of the first opinion discussing the *Motion Picture* case and basing the decision squarely on that case.

tubes to which were applied exactly the same restrictive notice as to field of use, that we are considering in this case. The infringement charged was the defendant's use of those vacuum tubes in the commercial field of radio communication between ship and shore for pay which was outside of the licensed field. The Court was not required to pass upon the validity of that restriction and did not do so. But in the statement of the case this Court did not suggest any doubt that it was valid. The Court said (p. 461):

> "• • • there came from the DeForest Company to the Radio Corporation, exclusive rights to use and sell in the United States, for radio purposes, apparatus for transmission of messages, and especially for use between ship and shore for pay.
>
> "*The defendant, the Independent Wireless Company, has bought the same apparatus with the lawful right to use it in the amateur and experimental field only.* The apparatus thus bought bears a label with such a limitation on its use. The charge in the bill is that the Independent Company is using the apparatus, or the part of it called 'radio tubes', in the commercial radio field between ship and shore for pay and thus is violating the Radio Corporation's rights in this field."

The statement that defendant bought the apparatus "*with the lawful right to use it in the amateur and experimental field only*" is believed to be significant.

The Decisions Relied upon by Petitioner:

As we have indicated, petitioner's primary reliance in support of its contention that the restriction which we are considering, is invalid and unenforceable even against a purchaser with notice, is upon broad language used by this Court to the effect that the authorized sale of a patented device takes it outside of the patent monopoly. Petitioner seeks to construe this language as meaning that there is nothing that the patentee can do to prevent this result; that the implication that an unrestricted license

goes with the passage of title cannot be overcome in any way, not even by specific notice to the purchaser at the time of the sale that only a restricted license is granted.

We do not believe that this Court ever intended the language in question to be interpreted as broadly as this but quite the contrary. Construed in the light of the cases in which it originated, we believe that this language should be confined to unrestricted sales, which concededly have the effect stated.

1. *Cases relating to Time of Use:*

The cases of this character to which petitioner refers,[1] like *Mitchell* v. *Hawley,* 16 Wall. 544,[2] involved questions arising out of extensions of the term of patents, under Section 18 of the Patent Act of 1836, or special Acts of a similar character.[3] The decisions in the first two of these cases, cited by petitioner, *Wilson* v. *Rousseau,* 4 How. 646 and *Simpson* v. *Wilson,* 4 How. 709, were confined to an interpretation of this particular Section of the Act of 1836. They held that the benefit of an extension obtained under it did not inure to one who was a *territorial assignee* for the original term of the patent because the purpose of the Act was to benefit the inventor and not his assignees, but that the last sentence of the Section meant that one who had purchased a patented machine in the ordinary course (*i. e.,* without any restriction as to the length of time it could be used) from the patent owner during the original term, could continue to use it during the extended term (p. 684).[4] These decisions, confined as they are to the interpretation of a particular

[1] Brief, pages 13, 14.

[2] *Supra,* pages 16-19, 29. [3] *Supra,* page 17.

[4] It will be recalled that the last sentence of the statute expressly provided that "the benefit of such renewal shall extend to *assignees and grantees of the right to use* the thing patented, to the extent of their respective interests therein."

statute, give no support to petitioner's proposition that "the sale of a patented chattel exhausts the patent rights of the seller".[1]

The first of the cases from which petitioner quotes in attempting to support this proposition is *Bloomer* v. *McQuewan*, 14 How. 539. *It is the first case in which this Court used the broad language upon which petitioner relies.* The respondents had purchased the right to construct and use certain patented machines, *without limitation.* They had constructed some of those machines, and continued to use them after the expiration of the original term of the patent. The term of the patent was extended by a special Act of Congress. The patent owner sought to enjoin respondents' further use of these machines.

Under the general provisions of the Act of 1836 relating to extensions of patents[2] respondents would have had the right to continue to use these machines during the extended term because they had previously acquired an unlimited "right to use" them. *Wilson* v. *Rousseau*, 4 How. 646, *supra*. The question before the Court was whether that same situation obtained under the special Act under which this particular patent had been extended. The Court held that it did, finding that Congress intended the special Act to be subject to the general provisions of Section 18 of the Act of 1836. The Court said (pp. 553, 554):

> "The right to construct and use these planing machines, had been purchased and paid for without any limitation as to the time for which they were to be used. They were the property of the respondents. Their only value consists in their use. And a special act of congress, passed afterwards, depriving the appellees of the right to use them, certainly could not be regarded as due process of law.
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> * * * * * * * *

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[1] Brief, page 13.

[2] *Supra*, page 17. See particularly the sentence of this Act quoted in footnote on the preceding page.

> "• • • we are of opinion that this special act of congress does not, and was not intended to interfere with rights of property before acquired; but that it leaves them as they stood during the extension under the general law [relating to extensions]."

Accordingly, the injunction sought by the patent owner was denied. The Court's reference to the effect of a *sale*, which petitioner quotes,[1] was merely by way of repeating the reason given in *Wilson* v. *Rousseau, supra,* for the holding that the last sentence of Section 18 of the Statute of 1836 applied to ordinary (unrestricted) purchasers of machines during the original term of the patent, but not to territorial assignees or grantees of the patent. The Court's entire statement in this regard (of which petitioner has quoted only the last paragraph) is as follows (p. 549):

> "Now, the act of 1836, in express terms, gives the benefit of the extension authorized by that law to the assignees and grantees of the right to use the thing patented to the extent of their respective interests therein. And under this provision it was decided, in the case of *Wilson* v. *Rousseau,* 4 Howard 688, that the party who had purchased and was using this planing machine during the original term for which the patent was granted, had a right to continue the use during the extension. And the distinction is there taken between the grant of the right to make and vend the machine, and the grant of the right to use it.
>
> "The distinction is a plain one. The franchise which the patent grants, consist altogether in the right to exclude every one from making, using, or vending the thing patented, without the permission of the patentee. This is all that he obtains by the patent. And when he sells the exclusive privilege of making or vending it for use in a particular place, the purchaser buys a portion of the franchise which the patent confers. He obtains a share in the monopoly, and that monopoly is derived from, and ex-

[1] Brief, page 14.

ercised under, the protection of the United States. And the interest he acquires, necessarily terminates at the time limited for its continuance by the law which created it. The patentee cannot sell it for a longer time. And the purchaser buys with reference to that period; the time for which exclusive privilege is to endure being one of the chief elements of its value. He therefore has no just claim to share in a further monopoly subsequently acquired by the patentee. He does not purchase or pay for it.

"But the purchaser of the implement or machine for the purpose of using it in the ordinary pursuits of life, stands on different ground. In using it, he exercises no rights created by the act of congress, nor does he derive title to it by virtue of the franchise or exclusive privilege granted to the patentee. The inventor might lawfully sell it to him, whether he had a patent or not, if no other patentee stood in his way. And when the machine passes to the hands of the purchaser, it is no longer within the limits of the monopoly. It passes outside of it, and is no longer under the protection of the act of congress."

This last paragraph must be construed with its context and in light of the provision of the statute which gave to those who had previously acquired "the right to use" a machine "the benefit of the renewal". As so construed, it is clearly confined to the effect of ordinary *unrestricted* sales, *as was subsequently held in Mitchell* v. *Hawley*, 16 Wall. 544, *upon which we rely.*[1] The statement has nothing to do with sales of the character with which we are here concerned, namely, sales accompanied by notice to the purchaser that he receives with the machine only a limited license to use it.

It should also be observed that the *Bloomer* case did not involve a sale of the patented machines but merely the license or "right to construct and use" those machines, as stated in the opinion.[2] Therefore, there was no occasion

[1] *Supra*, pages 16-19, 29. [2] *Supra*, page 39.

for the Court to discuss the effect of such a sale and the statement made is in fact a *dictum*. Nor should it be forgotten that this was the first case in which the Court used the broad language upon which petitioner relies and that the decision was based on the express provision of the Act of 1836 that gave the benefit of patent extensions to all persons who had before acquired the "right to use the thing patented".[1]

The two *Wilson* cases and the *Bloomer* case are the only cases relating to time of use, which petitioner mentions. Petitioner makes no reference in this connection to the decision of this Court in the only such case which is really pertinent, namely, *Mitchell* v. *Hawley*, 16 Wall. 544. And that case, which is the latest of the group, holds, as we have seen, that restrictions limiting the time of use of the device are valid and enforceable against a purchaser who is chargeable with knowledge of those restrictions. Moreover, as we shall see, in every subsequent case in which this Court has used the broad language, which originated under the special circumstances in the *Bloomer* case, that language was unnecessary to the decision.

2. *Cases relating to Place of Use:*

The first of these cases relied upon by petitioner is *Adams* v. *Burke*, 84 U. S. 453, 459. In that case a Boston manufacturer was a territorial assignee of the patent for a coffin lid, having acquired from the patentees "all the right, title, and interest which the said patentees had in the invention described in the said letters-patent, for, to, and in a circle whose radius is ten miles, having the city of Boston as a center" (p. 458). He sold

[1] It is of considerable interest to note that the statute itself appears to recognize the difference between mere ownership of a patented article and the right to use it because it gave the benefit of the patent extension to any one who had "the right to use the thing patented" quite irrespective of his title to the thing itself.

one of those coffin lids *unconditionally* to the defendant *in* Boston, as he, being the assignee of the patent for that territory, had a perfect right to do. Defendant used that lid outside of the ten mile limit and was charged by the patentees with infringement for so doing. Since the defendant had bought it without condition from an assignee who had the right to make such a sale, this Court refused relief to the patentee. The Court specifically held that the lid had been "lawfully made and sold" (17 Wall. 453, 457). It is in the light of these facts that the following language quoted by petitioner[1] from this decision, must be construed:

> "But, in the essential nature of things, when the patentee, or the person having his rights, sells a machine or instrument whose sole value is in its use, he receives the consideration for its use and he parts with the right to restrict that use. The article, in the language of the Court, passes without the limit of the monopoly." (Note particularly that the Court here cites *both Bloomer* v. *McQuewan* and *Mitchell* v. *Hawley, supra.*)

As so construed, it clearly applies only to *unconditional* sales. Otherwise, the Court would not have taken the pains at the end of its opinion (p. 457) to point out that——

> "when they [patented devices] are once lawfully made and sold, there is no restriction on their *use*[2] to be *implied* for the benefit of the patentee or his assignees or licensees."

In the case at bar, we are not dealing with *implied* restrictions but with *express* restrictions of which the purchaser is notified at the time of the sale.

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[1] Brief, pages 14, 15.

[2] The word *use* is italicized in the original, but the word *implied* is not.

Hobbie v. *Jennison*, 149 U. S. 355, referred to by petitioner at page 15 of its brief, involved substantially the same state of facts and the same question as *Adams* v. *Burke, supra.* The only difference was that in this case the suit was brought against the territorial assignee rather than his vendee. The decision of the Court was the same. Since the territorial assignee had absolute title to the patent for his particular territory, it was held that he could sell the patented articles in that territory without imposing any restrictions upon the place where the purchaser might use them, and that he could do so even if he knew that the purchaser intended to use them outside of that territory. This defendant's right to vend in his particular territory, being unrestricted, is to be distinguished from the right to vend "*for use* in a particular place", to which this Court referred in *Bloomer* v. *McQuewan.*[1]

This *Hobbie* v. *Jennison* decision is of particular interest because of the Court's comment (pp. 363, 364):

> "It is easy for a patentee to protect himself and his assignees, when he conveys exclusive rights under the patent for particular territory. He can take care to bind every licensee or assignee, if he gives him the right to sell articles made under the patent, by imposing conditions which will prevent any other licensee or assignee from being interfered with. There is *no condition or restriction in the present case* in the title of the defendant."

This would seem to indicate very definitely that it is possible to impose effective restrictions upon the use of a patented device, at the time of its sale.

Keeler v. *Standard Folding Bed Co.*, 157 U. S. 659, which is cited and quoted from at pages 15, 16 of petitioner's brief, is on all fours with *Adams* v. *Burke, supra,* and need not be discussed separately. The defendant had purchased the patented articles, *free from restrictions,* from a territorial assignee who *had the right to make such a sale.* Therefore, those articles had passed outside of the patent monopoly.

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[1] *Supra,* page 40.

3. *"Attempted Restrictions on Resale Prices and Use":*

Under this heading, petitioner[1] groups the decisions of this Court in *Bauer* v. *O'Donnell*, 229 U. S. 1;[2] *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490;[3] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8,[4] and *Motion Picture Patents* v. *Universal Film Mfg. Co.*, 243 U. S. 502.[5]

Petitioner correctly says of the first three of these decisions that they "were concerned with the efficacy of attempted *resale price* restrictions". It is because they were concerned only with attempted restrictions of that particular character, that they are not pertinent here. As we have seen,[6] the Court held in those cases that resale price restrictions were void as beyond the protection and purpose of the patent act and as against public policy. Where such a restriction, which is void *per se*, is the only one attempted to be attached to the sale of a patented article, the result is the same as if the sale had been unrestricted. An unlimited license is implied and the article passes outside of the patent monopoly. But this is not so where the restriction itself is a proper exercise of the patentee's exclusive rights, as is the restriction upon the use of the patented machine itself, with which we are concerned in this case. In none of the resale price cases did the Court have occasion to consider restrictions of this character and it did not do so.

At page 17 of its brief, petitioner quotes from the decision in the *Boston Store* case, 246 U. S. 8, 23, a portion of this Court's comment on the *Bauer* v. *O'Donnell* decision.

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[1] Brief, page 16.

[2] *Supra*, pages 32, 33.

[3] *Supra*, pages 20, 33.

[4] *Supra*, page 33.

[5] The old Circuit Court case of *Washing Mach. Co.* v. *Earle*, 29 Fed. Cas. 332 (Case No. 17,219), referred to by petitioner on pages 8 and 36-37 of its brief, is merely one of a number of similar cases, decided *before* this Court's decision in *Mitchell* v. *Hawley*, and involved an *unrestricted* sale by a licensee.

[6] *Supra*, pages 32, 33.

In this quotation, petitioner omits the statement of the Court (p. 23, bottom):

> "As the case dealt with the right to vend under the patent law, the Court reserved any express statement concerning the scope of the right to use conferred by that law."

That statement would seem completely to dispose of *Bauer* v. *O'Donnell* as a precedent for the instant case.

Concerning the *Motion Picture Patents* case, petitioner says (p. 16) that it was concerned "with attempted limitations on *use*" (italics petitioner's). That is true only in a very broad sense, for as we have seen, the restrictions there involved related *not* to "the use of the [patented] machine itself", but to "the use of the supplies only", and specifically to the use of films which were not covered by the machine patent in suit but by a separate, *expired* patent. And it was upon the basis of that distinction, that the Court held those restrictions unenforceable under the patent law.[1]

In reference to the *Motion Picture Patents* decision, this Court did say, in its *Boston Store* decision, 246 U. S. 8, 25, as quoted by petitioner (p. 17):

> "Reiterating the ruling in the two last cases [referring to *Bauer* v. *O'Donnell* and *Straus* v. *Victor Talk-*

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[1] Petitioner's partial quotation from the *Motion Picture Patents* case at the top of page 26 of its brief might perhaps be misleading. Petitioner there states that in that decision the Court held "that its previous decision in *Bauer* v. *O'Donnell* had interpreted the exercise of the right to vend, as freeing the article 'of every restriction which the vendor may attempt to put upon it' (*Motion Picture Patents* case, 243 U. S. 502, 516)." Petitioner should have started its quotation earlier, for what the Court actually said was that in *Bauer* v. *O'Donnell*, it had declared that (p. 516):

> "the right to vend is exhausted by a single, *unconditional* sale, the article sold being thereby carried outside the monopoly of the patent law and rendered free of every restriction which the vendor may attempt to put upon it." (Emphasis ours.)

> *ing Machine Co.*] it was again decided that, as by virtue of the patent law, one who had sold a patented machine and received the price, and had thus placed the machine so sold beyond the confines of the patent law, could not, by qualifying restrictions as to use, keep under the patent monopoly a subject to which the monopoly no longer applied."

The "subject to which the monopoly no longer applied", mentioned in the last two lines of this statement, clearly has reference to the films (supplies), the patent upon which had expired, but which the plaintiff was attempting to monopolize under the unexpired patent upon the machine. The statement that the Court had held in the *Motion Picture Patents* decision that one who had sold a patented machine "had thus placed the machine so sold beyond the confines of the patent law", is, we believe, inaccurate. If, at the time of that decision, the Court had been of *that* view, it certainly would not have gone to such pains in that decision to explain that (p. 512)[1]—

> "The difference is clear and vital between the exclusive right to use the machine which the law gives the inventor and the right to use it exclusively with prescribed materials to which such a license notice as we have here seeks to restrict it",

and it would not have held the restrictions there involved (p. 518)—

> "invalid *because* such a film is obviously not any part of the invention of the patent in suit."

And, of course, the *Boston Store* case did not require any ruling upon the validity of restrictions upon the *use* of the patented machine, for it was concerned only with restrictions attempting to fix resale prices.

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[1] *Supra*, page 35.

The last of the cases cited by petitioner in support of its position,[1] is *United States* v. *General Electric Company, et al.*, 272 U. S. 476, 489, where this Court again repeated the broad statement of the earlier cases. This case did not involve any question relating to the validity of restrictions imposed at the time of the sale. The restriction there in controversy was one contained in a license granted by a patentee to a manufacturing licensee fixing the price at which the latter could sell patented articles made by it under the license. The Court held that restriction *valid*, specifically reaffirming the doctrine of *Bement* v. *National Harrow Co.*, 186 U. S. 70.[2]

With regard to each of the decisions of this Court, from which petitioner quotes broad language in attempted support of its position, we might say, as this Court did of a case cited by one of the litigants in *Plumley* v. *Massachusetts*, 155 U. S. 461, 474:

> "It is sufficient to say * * * that it did not in form or in substance present the particular question now under consideration."

Similarly, in *Tyson* v. *Banton*, 273 U. S. 418, 433, this Court said:

> "There is some general language in the [cited] opinion which, superficially, might seem broad enough to cover cases like the present one. It was said, for example (p. 126): 'Property does become clothed with a public interest when used in a manner to make it of public consequence, and affect the community at large.' Literally, that would include all the large industries and some small ones; but *in accordance with the well settled rule the words must be limited to the case under consideration.*"[3]

The broad language which petitioner quotes from this Court's decisions is substantially the same as that used

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[1] Brief, page 30. [2] *Supra*, page 25.

[3] Other cases to the same effect include *Cohens* v. *Virginia*, 5 U. S. 82, 97, 98; *Weaver* v. *Palmer Bros. Co.*, 270 U. S. 402, 414; *Home Bldg. & Loan Ass'n* v. *Blaisdell*, 290 U. S. 398, 434.

by *Robinson on Patents*, Sec. 824,[1] in stating that the usual sale of a patented article "delivers it from all the restrictions of the patent".

But Robinson adds, as this Court did, in effect, in *Mitchell* v. *Hawley*,[2] and as it might well have done in the decisions cited by petitioner had it been considering conditional or restricted sales, as well as unconditional ones:

> "To have that effect, however, the sale must be a lawful and *unconditional* sale."

And he then proceeds to point out that—

> "any person having the right to sell may at the time of sale restrict the use of his vendee within specific boundaries of time or place or method, and these will then become the measure of the implied license arising from the sale."

That, we believe, is the true rule.

This Court has never held otherwise with respect to restrictions *upon the use of the patented device itself*. And it has held restrictions, limiting the *time* of their use, valid and enforceable. *Mitchell* v. *Hawley*, 16 Wall. 544.[3] We believe that on the same reasoning, and under the same general rule, reasonable restrictions on the *field* of use, such as that in the case at bar, should be upheld.

Other Authorities Cited by Petitioner:

On page 27, petitioner quotes all of the following quotation from the 1937 Edition of Williston on Contracts, Volume 5, paragraph 1647, pages 4630-31, *except* the next to the last sentence which we have put in italics:

> "* * * It seems, indeed, to have been *suggested* by the Supreme Court of the United States, that as to patented articles there is an inherent inconsistency in selling property and imposing a restriction on the

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[1] *Supra*, page 26.

[2] *Supra*, pages 16-19, 38.

[3] *Supra*, pages 16-19, 38.

buyer.[14] [1] This can only mean, however, that the patent laws give no protection to restrictive promises exacted from a buyer and that they must stand or fall under the common law as if the article was unpatented. *Probably this depends on whether such a contract or condition is part of a scheme to obtain a monopoly wider than that of the patented article.*[15] Certainly this result cannot be achieved by mere notices on patented articles.[16]''

In note 15 Williston cites *Carbice Corp.* v. *American Corp.*, 283 U. S. 27. And, in note 16, he cites, in addition to the *Carbice* case, *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490, and the *Motion Picture Patents* case, 243 U. S. 502.

As Williston says in note 15, the *Carbice* case holds that a patentee cannot lawfully exact as a condition of a license that *unpatented* materials used in connection with the invention shall be purchased exclusively from him, and that, therefore, one supplying such *unpatented* accessories to the licensee to be used in disregard of the condition is not liable as a contributory infringer. Thus, it clearly appears from the complete quotation from Williston that he is of the opinion that there is nothing inconsistent in "selling property and imposing a restriction on the buyer", and he believes that restrictions which are within the patent monopoly and not "part of a scheme to obtain a monopoly *wider* than that of the patented article" as in the *Motion Picture* and *Carbice* cases, are valid and enforceable.[2] It is perhaps unnecessary to state that petitioner's partial quotation from this authoritative work is misleading in the extreme. In the same chapter

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[1] Note that Williston does not say that this Court has held this, but only that it has "suggested" it; also, that Williston cites in his note 14 *Boston Stores* v. *American Graphophone Co.*, 246 U. S. 8, which, as we have seen (*supra*, pp. 45-46) involved a resale price restriction.

[2] On page 8 of its brief, petitioner is at great pains to create the impression that the patented amplifier here involved is "a standard article of commerce" such as was the solid carbon dioxide sought to be restricted in the

of Williston's work (paragraph 1642 which precedes the paragraph from which petitioner quotes) Williston deals generally with restrictions accompanying the sale of property. He says on page 4603:

> "• • • Similarly, a buyer may make a reasonable contract restricting himself from using the property which he has bought in a way which would compete with the seller, or be obnoxious to him."

and cites numerous cases in support thereof. And again, on pages 4604 and 4605, Williston states:

> "The only limits imposed by the law on the owner of property restricting his power to exact contracts from a subsequent purchaser to refrain from using the property in a certain way are those imposed by public policy, and though public policy forbids unreasonable restraint of trade, and therefore forbids a system of contracts attempting to control prices on resale, *there seems no reason why it should prohibit contracts which reasonably protect a business of either buyer or seller without tending to affect the public injuriously by monopoly or enhancement of prices.*"[1]

Carbice case. The solid carbon dioxide was, of course, not patented and was well known. All that petitioner is really saying is that the patented amplifiers here involved have been extensively used, as it has elsewhere admitted.

[1]On page 11 of its brief, petitioner makes the suggestion that the decision below would, for example, enable a patentee to prevent the owner of a patented pocket lighter from using it for lighting cigars while permitting its use for lighting cigarettes. As to this, it is perhaps enough to say that the use is the same and, what is more, the restriction would be wholly unreasonable and capricious. As Williston makes clear, even at common law where no statutory monopoly is involved, it is only reasonable restrictions which will be enforced, such as those in the present case, "which reasonably protect a business of either buyer or seller without tending to affect the public injuriously or enhancement of prices". See also *Fred Waring* v. *WDAS Broadcasting Station, Inc.* (Pennsylvania Supreme Court), 35 U. S. P. Q. 272, *infra*, page 61.

Also, on page 27 of its brief, petitioner quotes two short sentences from page 1002 of Professor Chafee's scholarly article of nearly one hundred pages on Equitable Servitudes on Chattels in 41 Harvard Law Review 945. We commend this article to the Court, and suggest that it establishes a very strong case for the enforcement of reasonable restrictions, such as that involved in the present case, on the use of chattels.

Again on page 27 of its brief, petitioner quotes the following sentence from Section 347 of Walker on Patents, 6th Edition:

> "But the purchaser of a patented apparatus, from the owner of the patent thereon, acquires whatever right that patent covers, to use that apparatus in accordance therewith, even where it is capable of a different use,[22] and by such sale the apparatus is thereby rendered free of every restriction which the patentee may attempt to put upon it.[22a] "

Walker cites in note 22 only the case of *Edison Electric Light Co.* v. *Peninsular Co.*, 101 Fed. 831 (C. C. A. 6), in which, as clearly appears from the opinion, the sale of the apparatus was *without reservation of any kind.* Petitioner omits any reference to this case in the quotation in its brief. In note 22a, Walker cites, as petitioner indicates, *Straus* v. *Victor Talking Machine Co.*, 243 U. S. 490 and the *Motion Picture Patents* case, 243 U. S. 502, which, as we have seen, involved, respectively, restrictions on the resale price of the article sold and on unpatented supplies. Petitioner omits to quote the following sentence which appears earlier in the same paragraph in Walker:

> "Nor does a sale, coupled with an express license to use, give any right to use after the license has been forfeited or has expired.[17] The purchaser of a patented thing gets no other right to use it than such right as the seller had an express or an implied right to convey.[18] "

In note 17 Walker cites the case of *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536, to which we have

previously referred[1] and in which the use of certain patented machines, which had been sold conditioned upon payment of royalty up to a certain date, was thereafter enjoined, since no agreement concerning royalties had been made after the expiration of the stipulated period. And in note 18, Walker cites *International Pavement Co.* v. *Richardson*, 75 Fed. 590, 594, in which the defendant was enjoined from using or disposing of certain patented machines the title to which he had acquired by sale from a licensee, the defendant having failed to pay the reserved royalty to the patentee.

There is nothing inconsistent between the sale of a patented device and the simultaneous grant of a restricted license limiting its use to a particular field:

It is, of course, clearly established that the ownership of a *patented* device is entirely distinct from the right under the patent to sell or to use that device, and does not, *per se*, imply any such right. We have already referred to the statement of this Court in *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490, that the holder of a license to make and use the patented devices but not to sell them, *owns* the devices made under that license and may use them, but that—

> "* * * if he *sells* them, he infringes the right of the patentee, and may be held for damages and enjoined" (*supra*, p. 13).

Concerning the right of use, Judge Nixon said in *Wortendyke* v. *White*, 2 B. & A. 25, 28:

> "Confusion on this subject, has, doubtless, arisen from not distinguishing between the ownership of a patented machine and the right to use it. The one does not always include the other."

An ordinary infringer has title to the machine which he has made or acquired, but he may be enjoined from using it.

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[1] *Supra*, page 31.

Similarly in *Belknap* v. *Schild*, 161 U. S. 10, it was stated (p. 24):

> "Title in the thing manufactured does not give the right to use the patented invention. * * *"

To illustrate the application of this principle, we shall take the case of a patentee who has a patent for an amplifier, and who is engaged in the business of supplying amplifiers of his patent to theatres for use in talking picture equipment. Under the patent laws this patentee has the right "to exclude everyone from making, using or vending the thing patented, without * * * [his] permission". *Bloomer* v. *McQuewan*, 14 How, 539, 549.[1] He is unwilling to permit anyone to use the patented invention in the theatre field upon any terms. However, for a reasonable consideration, he is willing to permit the patented amplifiers to be used in homes, where they will not interfere with his theatre supply business.

There are several ways in which this patentee can permit another to use one of the patented amplifiers in his home, and still retain the right under the patent to enjoin as an infringement the use of that amplifier in a theatre.

One way is for him to license the prospective user for a lump sum, to make one of the patented amplifiers and to use it in his home only. The licensee will own the amplifier which he makes under this license. But, as pointed out above, the ownership does not carry with it any right to use the patented thing. The right to use it comes solely from the license to use, and is restricted to the terms of that license. Therefore, if the owner uses the patented amplifier outside of the terms of that license (for example, in a theatre) he is liable as an infringer. We think that there can be no dissent from this proposition.

Another way in which the patentee can accomplish the same result is to license the prospective user, again for a lump sum, to have one of the patented amplifiers made

[1] *Supra*, page 12.

for him by some third person, and to use that amplifier in his home only. The same principle would apply, as before, and again the patentee's right to hold the licensee liable as an infringer, if he exceeded the restrictions of his license to use, could not be questioned.

But suppose that the licensee, instead of making the amplifier which he is to use under his license, or having some third party make it for him, desires to purchase it from the patentee himself, and that the patentee is willing to sell it to him. There would appear to be no reason why the patentee, for a lump sum, could not grant the licensee a restricted license to use one of the patented amplifiers only in his home, and at the same time convey to him the amplifier to be used under that license, without sacrificing his right to enforce the restrictions of the license. Surely, the carefully restricted express license which the patentee granted and the licensee accepted, should not be denuded of its restrictions merely because title to the vehicle for the enjoyment of that license happened to pass from the patentee to the licensee, instead of from some third person to the licensee, with the patentee's permission.

It is true that in such a transaction, the patentee would have received full consideration for everything that he had sold, that is, full consideration for the restricted license that he granted and, we will assume, a reasonable manufacturing profit upon the amplifier itself. But he would not have sold a license to use the amplifier in a theatre, *and he would not have received any consideration for such a license.* As was said in *Porter Needle Co.* v. *National Needle Co.*, 17 Fed. 536, 537,[1]

> "the mere value of a patented machine is often * * * insignificant in comparison with the value of its use."

Furnishing the patented amplifiers to theatres was this patentee's livelihood and he was unwilling to grant

[1] *Supra*, page 31.

to anyone for any consideration any right under his patent, which would interfere with that business. If he had been willing to fix any terms upon which he would permit others to use the patented amplifiers in that field, undoubtedly those terms would have involved a very much greater payment than the one he accepted for the license for home use only. Clearly the receipt by the patentee of the consideration he asked for permitting a *specified restricted use* of his patented device should not be interpreted as consideration for permitting any and every use of it.

The transaction which we have just described as comprising the grant of a restricted license to use a patented device only in a specified field, and the simultaneous sale to the licensee of a device to be used under the license, differs in form only, from the transaction which petitioner says gives the purchaser an unrestricted license, namely, the sale by a patentee of one of his patented devices with notice brought home to the purchaser that he is licensed to use it only in a specified field. In the latter case, as in the former, there would appear to be no sound reason why the restricted character of the license granted should be affected in any way by the circumstance that the grant is accompanied by the sale of the patented device.

Ownership of a patented device is not inconsistent with the possession by the owner of only a restricted right to use that device. The mere fact that the ownership was acquired from the patentee, should not make it so. And, as we have seen, the authorities hold that it does not.

If the restrictions are not in themselves void as against public policy—and reasonable restrictions upon the field of use of the patented machine itself clearly are not because they are *within* the monopoly granted to the patentee—they are enforceable under the patent law against a purchaser with notice of them.

The restrictions involved in the present case are not contrary to public policy:

The argument of public policy, upon which are based the decisions of this Court regarding attempts to fix resale prices or to extend the scope of a patent monopoly beyond the statutory grant by compelling the purchaser of the machine to buy his supplies from the patentee, has no application whatever to restrictions of the sort here involved.

Obviously there is no public policy which requires the owner of a patent to allow others to use the patented invention itself against his will in any field.

> "If he [patentee] sees fit, he may reserve to himself the exclusive use of his invention or discovery. If he will neither use his device nor permit others to use it, he has but suppressed his own, * * * his title is exclusive, and so clearly within the constitutional provisions in respect of private property that he is neither bound to use his discovery himself nor permit others to use it." *Paper Bag Patent Case,* 210 U. S. 405, 425, quoting from *Bement* v. *National Harrow Co.,* 186 U. S. 70, 90.

Particularly is there no public policy which prevents a patentee from restricting the use of the patented devices sold by him to specified fields, so as to preserve his right to the exclusive enjoyment of his invention in the field which he is himself cultivating—in this case the field of commercial talking motion pictures. We have already pointed out that public policy should favor the enforceability of such restrictions.[1]

The circumstances surrounding the granting of the license in this case to American Transformer Company, under the patents here in suit (and others), are illustrative of this point.

As is true of many inventions, the inventions of the patents in suit are useful for many purposes and in a number or fields. We have previously referred to the extensive

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[1] *Supra,* page 23.

development work done by the Telephone Company and the Western Electric Company beginning in 1912 when the electronic tube became available to them. This work was carried on at great expense as was also the similar intensive development work of the General Electric Company and its associated companies. As usually occurs in the early development of any new art, conflicting rights arose which made it impossible as a practical matter to develop the new art commercially without infringing valid patents adversely held. Therefore, in order to make fully available to the public the great benefits of the new art it was necessary for the companies, which had made the major contributions to the art, to enter into a license arrangement permitting each to use in its own business field or fields the inventions of the others. Consequently, the cross license agreement[1] between the Telephone Company and the General Electric Company was entered into in July, 1920, and certain rights thereunder were extended,[2] to the Western Electric Company, and the Radio Corporation of America, the latter company having been formed in the meantime to engage primarily in the business of radio communication for tolls.[3]

As appears from these agreements, each party granted rights under its patents to the others in certain specified fields only, the restrictions being necessary to protect the business of each licensor in its own particular business fields.

For example, Schairer, Vice President of the Radio Corporation, testified that[4] his company was unwilling to grant licenses or to sell apparatus for use in the business of radio communication for tolls which was a new business and the principal business for which the Radio Corporation was formed.

The only practical way to make the apparatus available to the public for amateur and experimental purposes, such for example as broadcast reception, was to sell it with restrictions on its use at a relatively low price, the

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[1] III, 1328.
[2] III, 1356.
[3] I, 515.
[4] I, 515 to 517.

return from which was in no way commensurate with the benefit which the purchaser would receive if he were permitted to use the apparatus for commercial purposes, such as wire or wireless telephony for tolls, talking motion pictures in theatres for profit, etc.[1]

Because of this situation, it was provided in the agreement of July, 1920 between the Telephone Company and the General Electric Company,[2] as follows:

> "4. Each party agrees that, so far as it is enabled so to do, it will in disposing of devices embodying inventions pertaining or applicable to vacuum tubes, or to generating, modifying, amplifying, transmitting or receiving electro-magnetic waves, or other devices or material the unrestricted sale of which would deprive the other party of rights to which it is entitled hereunder, use such precautions by contracts, restricted licenses or otherwise as may be necessary or advisable in order to prevent its customers or others from acquiring (by acquisition of devices from it or otherwise) licenses to use the same which the party disposing thereof has no right to grant."

This provision was also included in the modification of the same agreement entered into in July, 1926[3] and in the later substitute agreement of July 1, 1932[4] which was approved by the Government in the settlement of the Government suits (*United States of Am.* v. *Radio Corp. of Am. et al.*). The stipulation approved by the Government states:[5]

> "The petitioner, by its Department of Justice, has examined all of the Agreements attached hereto, and also the above-mentioned Substitute License Agreement (B2) and Agreements Relating Thereto, and finds no objection to them."

This Agreement (B2), thus approved by the Government, contains a number of provisions granting licenses

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[1] I, 516.
[2] III, 1347, Article VI, Par. 4.
[3] III, 1404, Article VI, Sec. 4.
[4] II, 784, Article VII, Sec. 4.
[5] II, 796.

restricted to various fields of use,[1] as has been stipulated is "common practice where a patented invention is applicable to different uses."[2]

The restricted licenses, contained in the contracts to which we have referred above, made possible the commercial development of radio broadcasting and broadcast reception in the home, etc. The Radio Corporation entered that field about 1919 and, since that time, has granted many licenses for the manufacture and sale by others of broadcast receivers, employing the inventions of the patents in suit. It was in keeping with its policy of developing and improving radio broadcast receivers, that the Radio Corporation, with the consent of the Telephone Company, in 1927 granted about thirty licenses[3] to different manufacturers, limited to the right to make amplifiers embodying these patents and to sell them "only for radio amateur reception, radio experimental reception, and radio broadcast reception".[4] One of these was the license granted to American Transformer Company, the vendor of petitioner's amplifiers (*id.*).[5]

If petitioner's argument is sound, then such limited licenses, restricted as to fields of use, can no longer be safely made; and a patentee having an important invention useful in many fields but having vital interests to protect in one field, can no longer sell or allow others to

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[1] II, 743.

[2] Stipulation, I, 585, *supra*, page 9.

[3] I, 333-335.

[4] III, 1415.

[5] Petitioner refers on page 7 of its brief to the cases of *Stanley Co., General Talking Pictures Corp.*, and *Duovac Radio Corp.* v. *Am. Tel. & Tel. Co. et al.*, 4 F. Supp. 80, on motion for preliminary injunction; and 18 F. Supp. 650, at final hearing. The preliminary injunction was never issued, and at final hearing a permanent injunction was refused. The only appeal which was filed by the plaintiffs was that of the petitioner here, General Talking Pictures Corp. Although its appeal was filed on July 13, 1937, it has never been perfected by printing or filing the record.

sell the patented devices for use in other fields, for, as soon as he does so, he exposes his own vital field to competition by others in the use of his own invention. The public, as well as the patentee, would suffer great damage by any such ruling.

Assume the case where a patented machine is sold by the patentee to a college laboratory with a condition that it should be used only for experimental purposes. Surely, it cannot be successfully contended that such a sale, made upon the express condition that the patented machine was not to be used commercially, gives the purchaser by law the unrestricted right to use the machine commercially in defiance of the restriction. If that were the law no such sale could be made at any reasonable price. Yet that, in substance, is what petitioner is contending in this case.

In short, to sustain the proposition for which petitioner contends, and to hold that a patentee cannot convey with the sale of his patented device, an effectively restricted license limiting the purchaser's right to use that device to specified fields, would be to subvert principles of patent law which have been universally accepted as true from the very beginning of our patent system, which have been sanctioned by many court decisions, and upon which, as a basis, innumerable patent licenses have been and are every day being granted.

There is no public policy, and no principle of law which compels or warrants any such ruling as that now asked by petitioner; and there is no decided case which, properly read, supports any such ruling.

The recent decision by the Pennsylvania Supreme Court in *Fred Waring* v. *WDAS Broadcasting Station, Inc.*, 35 U. S. Patent Quarterly 272:

This case, which was decided October 8, 1937, is of interest both because of its facts and the court's decision on those facts, and also because of the court's comments upon certain of the decisions of this Court which are relied upon by petitioner in the instant case.

In the cited case, Fred Waring's popular orchestra, the "Pennsylvanians", commanded sizable fees for its rendition over the radio of dance music and the like. It also made phonograph records of its rendition of such selections. These were sold to the public, marked "Not licensed for radio broadcasts". The defendant purchased one of these records. It had a license from the copyright owner to perform for profit the copyrighted selection in question. It did so by broadcasting the record of Waring's rendition of that selection. Waring brought suit to enjoin defendant's doing this. The injunction was granted by the lower court and its decision was affirmed by the Supreme Court of Pennsylvania. The ground adopted by the latter court was that Waring had a property right in his rendition of the selection in question, which was distinct from the rights of the owner of the copyright in the selection itself, and that in broadcasting that rendition from the record, the defendant was competing unfairly with Waring who was in the business of broadcasting that rendition for profit. It held that the "equitable servitude", in the form of restrictions which the license notice placed upon the use to which the record could be put after its sale, was proper and equitable under the circumstances and that the restrictions were enforceable at common law. The following comment of the court is of particular interest here (pp. 277, 278):

> "• • • The most common type of case in which such restrictions have been held unenforceable is where an attempt was made by a manufacturer or the owner of a patent, trade mark or copyright to fix a minimum resale price: Taddy & Co. *v.* Sterious & Co., 1 Ch. (1904) 354; McGruther *v.* Pitcher, 2 Ch. (1904) 306; Bobbs-Merrill Co. *v.* Straus, 210 U. S. 339; Park & Sons Co. *v.* Hartman, 153 Fed. 24; Dr. Miles Medical Co. *v.* Park & Sons Co., 220 U. S. 373; Bauer *v.* O'Donnell, 229 U. S. 1; Strans *v.* Victor Talking Machine Co., 243 U. S. 490; Boston Store of Chicago *v.* American Graphophone Co., 246 U. S. 8; Garst *v.* Hall & Lyon Co., 179 Mass. 588; Garst *v.* Wissler, 21 Pa. Superior Ct. 532, or where there was

a provision that the article sold should be used only in connection with other property manufactured by the vendor: Motion Picture Patents Company *v.* Universal Film Manufacturing Co., 243 U. S. 502; Carbice Corporation of America *v.* American Patents Company *v.* Universal Film, 283 U. S. 26. These cases depend essentially upon the fact that the attempted restrictions, being in restraint of trade, were against public policy, * * *.

"* * * It is true that in addition to the question of public policy other factors may weigh against the imposition of such restrictions in many, perhaps most, instances. Thus an attempted restriction, instead of being aimed at the accomplishment of a useful commercial, industrial or social purpose, may be merely capricious and serve only to clog the free and untrammeled circulation of personal property. Again, in the case of some restrictive covenants limiting the use of chattels, it might be difficult, if not impossible, to detect breaches so as to make legal enforcement practical. There is no reason, however, why an ancient generalization of law should be held invariably to apply to cases in which modern conditions of commerce and industry and the nature of new scientific inventions make restrictions highly desirable. *Mere aphorisms should not be permitted to fetter the law in furthering proper social and economic purposes.*"[1]

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[1] The Court's attention is also called to the case of *Waterson, et al.* v. *Irving Trust Co.*, 48 F. (2d) 704, (C. C. A. 2), decided since the present case was brought, in which the court below held that certain music copyrights, after sale by a trustee in bankruptcy, were still subject to the composers' reserved rights to royalties. The authorities relating to equitable servitudes on chattels are extensively reviewed in the opinion by Judge A. N. Hand and numerous instances are cited of restrictions on the use of chattels which have been enforced by the courts. The opinion states (p. 708):

"Courts in the United States have enforced rights resembling an equitable servitude binding on a third party who has acquired personal property from one who is under a contract to use it for a particular purpose or in a particular way (Citing numerous cases)."

So, in the instant case, the oft repeated saying that the sale of a patented article frees it from the patent monopoly, should not be permitted to destroy reasonable restrictions upon the field of use of such articles where, as in the case at bar, those restrictions are clearly within the monopoly of the patent law, are not in their nature illegal or unreasonable, but serve a proper and desirable economic purpose.

It should not be forgotten that we are here dealing with a statutory grant, the extent of which must be determined from the statute itself as has been made clear by this Court in many decisions, including the *Motion Picture* case, *supra*, and *Dr. Miles Medical Co.* v. *Park & Sons Co.*, 220 U. S. 373, 401-402. Thus, even if it were true at common law—and it is not as we have seen—that after sale no restriction of any nature on unpatented personal property would be enforced, that would not control this patent case. Assuming the restriction upon a patented device is not unreasonable, the sole and only question is whether the restriction is within the statutory grant of the exclusive right to use. In addition to its holding in *Mitchell* v. *Hawley* (that restrictions on *time* of use of a patented machine are valid) this Court has recently indicated, if it has not actually held, in the *Motion Picture* case, *supra*, that restrictions which are on the use of the patented device itself are within the monopoly granted by the statute. It would therefore seem clearly to follow that this question should be answered in the affirmative.

We submit that on principle and authority, reasonable restrictions upon the field of use of a patented device sold under the patent, are valid and enforceable under the patent law as against a purchaser with notice of the restrictions. Therefore, petitioner would be an infringer even if the sale of the patented amplifiers to it had been *under* the patents, instead of *in infringement* of the patents.

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The decrees below should be affirmed.

Respectfully submitted,

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IN THE

Supreme Court of the United States

OCTOBER TERM, 1938

No. 1.

(No. 357, October Term, 1937, on Rehearing)

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC. and AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

MEMORANDUM FOR RESPONDENTS ON REHEARING.

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WESTERN ELECTRIC COMPANY, INCORPORATED, ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

MEMORANDUM FOR RESPONDENTS ON REHEARING.

The opinion of this Court in this case was rendered on May 2, 1938 and is reported at 304 U. S. 175. For convenience, the portion of that opinion that is pertinent to this rehearing is reproduced as an Appendix to this memorandum, in the format and with the paging of the official report.

This rehearing is confined by the order granting it, to two questions. In its opinion, this Court upheld the position, urged on behalf of respondents at the original hearing, that these questions are not involved in this case, and that, under well settled principles of patent law, petitioner is liable as an infringer for its use of amplifiers which admittedly embody the inventions of respondents' patents. Our presentation of that position will be found at pages 8 to 20 of the Brief for Respondents in this case, a "reprint" of Part I of which (including the pages cited) is filed herewith.

We adhere to that position, as there presented.

In the present memorandum we shall deal primarily with this Court's opinion and with petitioner's criticisms of it.

A.

This Court's Opinion in this Case.

The facts of this case are stated in this Court's opinion (304 U. S. 179, 180, *infra*), and also in our original brief (reprint, pp. 8-11).

The two questions to which this rehearing is confined by the order granting it are:

1. Can the owner of a patent, by means thereof, restrict the use made of a device manufactured under the patent, after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor?

2. Can a patent owner, by means of the patent, merely by a "license notice" attached to a device made under the patent and sold in the ordinary channels of trade by the patentee or by his licensee to make and sell, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device?

Petitioner has sought to bring this case within the purview of these two questions by stating that this suit is:[1]

> "an attempt, by means of *patents*,[2] to restrict the use of . . . [an] article . . . made and *sold thereunder* . . . ."

But, in its opinion, this Court found that the amplifiers in question had *not* been sold to petitioner *under* the patents, that is, had not been sold by the patent owner or with his authority, but had been acquired by petitioner through *infringing* sales. It was for that reason that it concluded that petitioner's questions were not involved in this case.

The Court said (p. 181):

> "There is no warrant for treating the sales of amplifiers to petitioner as if made under the patents or the authority of their owner."

> "The patent owner did not sell to petitioner the amplifiers in question or authorize the Transformer Company to sell them or any amplifiers for use in theaters or any other commercial use" (p. 180).

The Transformer Company was licensed to sell them (p. 181):

> "*only* for radio amateur reception, radio experimental reception and radio broadcast reception. . . ."

> "It had no right to sell the amplifiers for use in theaters as a part of talking picture equipment.
>
> "Nevertheless, it knowingly did sell the amplifiers in controversy to petitioner for that use" (p. 180).

Therefore—

> "The sales made by the Transformer Company to petitioner were outside the scope of its license and

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[1] Brief for petitioner on original hearing, page 11; brief on rehearing, page 8.

[2] Emphasis ours throughout unless otherwise noted.

> *not under the patent* . . . [a] fact [which] both parties knew . . . at the time of the transactions" (*id.*).
>
> • • • • • • • •
>
> "By knowingly making the sales to petitioner outside the scope of its license, the Transformer Company infringed the patents embodied in the amplifiers (citing cases). Petitioner, having with knowledge of the facts bought at sales constituting infringement, did itself infringe the patents embodied in the amplifiers when it leased them for use as talking picture equipment in theaters" (pp. 181, 182).

In our view, this decision is sound in every particular and should not be disturbed.

Petitioner's brief on rehearing presents no facts or arguments which were not presented on the original hearing and fully considered by the Court at that time, and no tenable reason why this decision should not stand.

Petitioner's criticisms of this Court's opinion are without merit.

Beginning at page 38 of its brief, petitioner presents its specific statement of why it considers that "This Court's prior decision in the present case was erroneous". The preceding part of the brief is devoted largely to a presentation of petitioner's views as to the legal effect of a sale of a patented device *under* a patent. Obviously, that subject, which has to do with the merits of petitioner's two questions, would be pertinent here only if this Court should reach the conclusion that it had erred in finding that under the circumstances of this case, the sale of amplifiers by the Transformer Company to petitioner was *not under* the patents but an *infringement* of them.

The Court did not err in its opinion in this or any other respect, as we shall now see, in replying to petitioner's specific criticisms of that opinion.

This Court did not err in holding that the Transformer Company's sales to petitioner were not sales *under* the patents, but were *infringing* sales.

The facts, as set forth in the above excerpts from the Court's opinion, are not now disputed by petitioner. It is not denied by petitioner that the license held by the Transformer Company was known by both parties to the transaction to be a *limited* license—

> "to manufacture . . . , and to sell *only* for radio amateur reception, radio experimental reception, and radio broadcast reception . . . ."

Nor is it denied that the sale of the amplifiers in question by the Transformer Company to petitioner was known by both parties to be a sale of amplifiers for use in talking picture reproduction, and not a sale of amplifiers for use in radio reception of any kind.[3]

Indeed, the record shows that these amplifiers, which comprise expensive sets of apparatus, costing petitioner between $400 and $500 per set,[4] were designed particularly for use in "talking pictures"[5] and were built "to fit the input circuit and the load" to which they were to be subjected by petitioner in that field (II, 732 fol. 2196). Petitioner's president, Schlesinger, went so far as

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[3] Petitioner's original brief, page 36.

[4] The two units making up the complete set of apparatus are designated A-41 and 25-A (II, 651). The prices which petitioner paid for these are given at III, 1591-1593.

[5] I, 407. The A-41 unit, a "Preliminary or Photo-Electric Cell Amplifier" (II, 651), is designed for mounting on the motion picture projector itself and contains special circuits adapted to pick up and amplify the very feeble currents produced by the variations of light falling upon the photo-electric cell. See Waterman's testimony, I, 71, 90, 174, 175, and photograph of photo-electric cell amplifier, II, 1204. While photo-electric cells are a necessary part of talking picture equipment, they are not used in radio reception.

to boast that he had told an executive of respondents that (I, 375):

> "They [the Transformer Company] are making it [the amplifier] practically for me alone, as I understand it, *my particular model*, and other models of a similar kind they are making for a few others."

These amplifiers were not adapted, without change, for use for radio reception, which is the only use for which the Transformer Company was licensed to sell them (I, 194, 195).

It is clear therefore that the Court made no error in its opinion in regard to the facts, or in regard to the state of knowledge of the parties at the time of the transaction.

Petitioner's only comment on this subject of knowledge (p. 42) resolves itself into the proposition that the Court erred in disregarding the "evidence" that "both parties acted on advice of counsel, and in the honest belief that the Transformer Company had the right to make these sales and the petitioner to make the purchases". Evidence of this character is wholly immaterial. That petitioner may not have been accurately informed as to the legal consequences of its acts, does not relieve it from those consequences.[6] The very fact that both parties consulted counsel on the matter before consummating the transaction, leaves no room for doubt that both of them were cognizant of every pertinent fact at the time of its consummation. Indeed, it shows that their infringing acts were deliberate.

Petitioner's primary criticism of the Court's holding that the transaction in question was an infringing sale and *not* a sale *under* the patents, seems to be based on the proposition that the Court should have disregarded entirely the limitation of the Transformer Company's license,

> "to sell *only* for radio amateur reception, radio experimental reception, and radio broadcast reception."

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[6] *Individual, etc. Co.* v. *Errett*, 297 Fed. 733, 741 (C. C. A. 2)

Thus petitioner says, for example, that a complete answer to the position taken by respondents (and by this Court in its opinion) is "the fact that the licensee undeniedly had the right to *sell*"[7] (p. 32); and again (p. 41) that "no action of the American Transformer Company, which was licensed to *sell*,' would determine whether or not infringement occurred". Petitioner asserts further (p. 34):

> "Nor is it of any legal consequence what the manufacturing licensee in this case believed or knew of the uses to which petitioner might put the amplifiers it purchased."

These contentions are fundamentally unsound.

Preliminarily, we remind the Court that knowledge or intent on the part of a seller has frequently been held a determining factor on the issue of infringement *even in the absence of an agreement making it so.*

Thus in *Leeds & Catlin* v. *Victor Talking Machine Co.*, 213 U. S. 325, 337, the defendants were held liable because they sold—

> "records *for use* in the Victor machine, 'an entirely voluntary and *intentional*' (to use the language of Judge Lacombe) contributory infringement."

Similarly, in *Morgan Envelope Co.* v. *Albany Paper Co.*, 152 U. S. 425, 433, this Court referred, with citations, to—

> "many cases to the effect that the manufacture and sale of a single element of a combination, *with intent* that it shall be united to the other elements, and so complete the combination, is an infringement."

In *Sandusky Foundry & Machine Co.* v. *De Lavaud*, 274 Fed. 607, 610 (C. C. A. 6), the Court said:

> "• • • Where defendants manufacture a device capable of an infringing use and sell it *with the intent* that it shall be so used, they infringe the

[7] Emphasis petitioner's.

> patent, even though their device is capable of a non-infringing use, and even though they go through the form of instructing that it shall be used in a non-infringing way."

To the same effect see *Westinghouse* v. *Precise Manufacturing Corp.*, 11 F. (2d) 209, 212 (C. C. A. 2).

In the instant case, the express limitation concerning the use for which the Transformer Company was licensed to sell amplifiers, was *of the essence of the license agreement*. It was a *definition* of the license grant itself. And it specifically made it of *controlling* "legal consequence" (to use petitioner's term) whether the Transformer Company knowingly sold amplifiers embodying the patented inventions, for use in fields other than those specified. It made the difference of whether the sales were *within* or *without* the scope of the license—non-infringing or infringing.

As this Court pointed out in its opinion (p. 181), a license is a mere waiver of the right to sue. Accordingly, the license which was granted to the Transformer Company and accepted by it might be stated by the licensor colloquially as follows:

> I will waive my right to sue you for infringement, for making and selling amplifiers *for radio reception* (amateur, experimental, or broadcast). But this waiver does *not* extend to any sales which you may make for use in other fields. It will not detract in any way from the infringing character of such sales.

Since the sales here in controversy were made by the Transformer Company *knowingly for use in another field*, even to the extent that the amplifiers which were sold had been particularly *designed* for use in that other field and to meet petitioner's particular requirements in it (*supra*, p. 5), they were not affected in any way by the license. They were outside of its boundaries. So far as those sales were concerned, the effect was exactly the same as if there

had been no license at all, including the fact that respondents did not benefit from the sales by way of royalties.[8]

It was not necessary, as petitioner suggests, to wait until the amplifiers had actually been put to their intended use by petitioner, before the infringing character of these sales to petitioner could be determined. That was determined the moment the amplifiers were knowingly sold by the Transformer Company to petitioner for that use. Petitioner, who likewise knew all of the facts and connived in that infringement, is surely in no position to deny this.

This Court was clearly right in giving full force and effect to the limitations of petitioner's license, and in holding, as the Court did:

> "The sales made by the Transformer Company to petitioner were outside the scope of its license and not under the patent. Both parties knew that fact at the time of the transactions. There is no ground for the assumption that petitioner was 'a purchaser in the ordinary channels of trade'" (180, 181).[9]

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[8] Royalties initially paid upon these sales by the Transformer Company were returned to that company by respondents' agent after the identity of the purchaser had been ascertained, and were accepted by the Transformer Company (III, 1645).

[9] In contending that this holding of the Court was erroneous, petitioner says (pp. 45, 46)

> "To point out the error it is merely necessary to refer to this Court's prior decision in *Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373, 408, as authority for the proposition that *any article sold* becomes
>
> > 'an article of commerce and the rules concerning the freedom of trade must be held to apply to it.'"

In the *Dr. Miles* case the Court was condemning a combination between dealers for "the destruction of competition and the fixing of prices" of certain unpatented *medicines*. The words quoted by petitioner are italicized

> "By knowingly making the sales to petitioner outside the scope of its license, the Transformer Company infringed the patents embodied in the amplifiers" (181, 182).

And this Court was right also in concluding that since petitioner had purchased its amplifiers at these infringing sales, with full knowledge of the facts, its subsequent use of them was an infringement (182).

The Court did not fail to recognize the true relationship between respondents and the Transformer Company, on the one hand, and between the Transformer Company and petitioner, on the other.

At pages 46, 47 of its brief, petitioner asserts that this Court failed to recognize the true relationships between these several companies, in the transaction with which we are concerned. It says also, apparently having reference to such decisions as *Bement* v. *National Harrow Co.*, 186 U. S. 70, 91, and *United States* v. *General Electric Co., et al.*, 272 U. S. 476, 490 (reprint, p. 25), that where the relationship of *patentee* to *licensee* exists (47)—

> "broad reservations of rights to patentees have been permitted, and are not here questioned."

This Court recognized very clearly the true relationships between the several parties. Respondents' general rela-

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in the following excerpt from the Court's opinion, which will give the context sufficiently (p. 408):

> ". . . No distinction can properly be made by reason of the particular character of the commodity in question [*i. e.*, because it is a medicine]. It is not entitled to special privilege or immunity. It is *an article of commerce and the rules concerning the freedom of trade must be held to apply to it.*".

It is evident that this has no bearing upon the situation with which this Court is here dealing.

tionship to the Transformer Company was accurately identified as that of *patentee* to *licensee*, which petitioner admits may involve "broad reservations of rights". And respondents' reservation of rights, represented by the limitation in the Transformer Company's license to sell, was held to be effective. *Because* that reservation of rights *was* effective, the Transformer Company was properly characterized by the Court as an *infringing seller*, in its relations to both respondents and petitioner, when it disregarded that reservation, and sold the amplifiers to petitioner outside the scope of its license.

In that role, the Transformer Company could convey no rights under respondents' patents.

This Court's opinion is in strict accordance with the authorities. It does not in any way "upset" the law, as petitioner asserts in its petition for rehearing.

As we have seen, this Court's decision holding petitioner's use of its amplifiers an infringement, was based upon the finding that petitioner, with full knowledge of the facts, had acquired those amplifiers at sales which were not *under* the patents but *infringements* of them—sales which the vendor had no authority from the patent owner to make.

In this respect this case differs decisively from every case relied upon by petitioner.

This Court's decision does not "upset the law" as petitioner asserts.[10] On the contrary, it is abundantly supported by the authorities cited in the Court's opinion (pp. 181, 182) which include those discussed in our brief on the original hearing (reprint, pp. 12, 13). The cases particularly relied upon by petitioner in this connection are

[10] Petition for rehearing, page 1.

discussed and distinguished in that same brief (reprint, pp. 16-20).

The Court's opinion in this case is merely an application of fundamental and well established principles of patent law to undisputed facts.

The Court's decision in this case is in the public interest. An opposite decision would tend to defeat the fundamental purposes of the patent laws.

The issue of law which this Court passed upon in its decision in this case might just as well have come up for decision in a case where a small business man stood in the shoes of the present respondents as the patent owner, and was pitted against a corporation of substantial resources, as the infringer who competed with him in his field by using there the patented devices which it had acquired through infringing sales.

Whoever the patent owner may be, who finds himself in this situation, it is only by invoking *against his infringing competitor*, the injunctive and other remedies provided by the patent laws, that he can protect himself in the enjoyment of the exclusive rights which he has acquired under the patent grant for a limited period, for the manufacture, use and sale of the *new thing* that is covered by his patent.

As this Court pointed out in its opinion (181):

> "Patent owners may grant licenses extending to all uses or limited to use in a defined field. *Rubber Company* v. *Goodyear*, 9 Wall. 788, 799-800. *Gamewell Fire-Alarm Telegraph Co.* v. *Brooklyn*, 14 Fed. 255. *Dorsey Rake Co.* v. *Bradley Co.*, Fed. Cas. No. 4,015, 7 Fed. Cas. 946, 947. Robinson on Patents, §§ 808, 824. Unquestionably, the owner of a patent may grant licenses to manufacture, use or sell upon conditions

not inconsistent with the scope of the monopoly. *Bement* v. *National Harrow Co.*, 186 U. S. 70, 93. *United States* v. *General Electric Co.*, 272 U. S. 476, 489.. There is here no attempt on the part of the patent owner to extend the scope of the monopoly beyond that contemplated by the patent statute. Cf. *Carbice Corp.* v. *American Patents Corp.*, 283 U. S. 27, 33, *Leitch Mfg. Co.* v. *Barber Co.*, 302 U. S. 458."

To deny a patent owner protection under the patent law against one who enters into infringing competition with him, in the way petitioner has done with respondents in this case, would seriously contract the patent monopoly, and be contrary to the public interest. It would reduce the incentive to invention, which it is the purpose of the patent laws to provide, and it would discourage the granting of *any* licenses by patent owners who desired to retain their exclusive rights in their own particular fields of endeavor.

Petitioner's assertion[11] that the decision involves "a grave injustice to the petitioner and the destruction of its business" can scarcely be intended seriously. The effect of the decision is merely to bring petitioner to book for the infringement which it committed when it leased to theaters for use in connection with talking picture equipment, patented amplifiers which it had purchased at sales known by it to be unauthorized by the patent owner and therefore in infringement of the patent. As we have said, petitioner having knowingly acquired the amplifiers at infringing sales, is in no better position than it would have been if it had acquired them from a manufacturer who had no license at all, or if it had made them itself. And there is no more "injustice" in holding petitioner liable for its infringement in the one case than there would be in the other.

Nor is there anything "drastically oppressive" in the decision of this Court in this case, as petitioner asserts (p. 44), or anything even savoring of "oppression". That

[11] Petition for rehearing, page 1.

assertion seems to be based upon the fantastic suggestion (*id.*) that this decision might lead the owner of a fountain pen patent to grant a license to some one to sell the patented pens only for use in signing letters, or the owner of an automobile patent to grant a license to some one to sell the patented automobiles only for transporting adults, etc. These suppositious limitations are obviously impractical and impossible of enforcement. No one would ever contemplate either granting, or accepting, a license containing them. They do not in any sense define distinct fields of use.

In the instant case, on the other hand, the uses for which the Transformer Company's license permits the sale of patented amplifiers, do constitute a distinct field of use, recognized as such in the industry. The use for which that company sold the amplifiers to petitioner and to which the latter put those amplifiers, is in another distinct field, recognized as such.[12] The limitations of that license are entirely reasonable and readily enforceable, and are well calculated to effect their lawful and legitimate purpose which is to protect respondents in the enjoyment of their exclusive patent rights. They are just such "reservations of rights" as petitioner says "are not questioned here".

The gist of this Court's decision is merely to give effect to those reservations. It is not a sound criticism of this decision that some *other* reservations might present different problems.

This Court's decision of May 2, 1938 was right in holding that the two questions propounded by petitioner are not applicable to the facts of this case and that therefore they do not require answer here. And it was right also

[12] As we have seen, those amplifiers were especially designed and constructed for use in this latter field (*supra*, p. 5).

in holding that under the circumstances of this case, the fact that petitioner purchased its amplifiers from the Transformer Company, did not constitute a defense to respondents' charge of infringement.

We respectfully submit that there is no reason for disturbing this decision.

B.

The Merits of Petitioner's Questions.

We believe that there is no occasion for us to discuss or for the Court to consider the merits of petitioner's questions, inasmuch as they are not involved in the present case. That was the view we expressed on the original argument. At that time, however, by way of replying completely to petitioner's brief, we presented a statement of our position upon the issues raised by the questions themselves (reprint, pp. 21-64). We now reiterate that statement, by way of replying completely to petitioner's brief on rehearing.

Respectfully submitted,

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Appendix.

The Pertinent Portion of the Opinion of this Court, as it appears in 304 U. S. 175 in

GENERAL TALKING PICTURES CORP. *v.* WESTERN ELECTRIC CO. ET AL.

CERTIORARI TO THE CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT.

No. 357. Argued December 13, 14, 1937.—Decided May 2, 1938.

Mr. Justice Butler delivered the opinion of the Court.

* * * * * * * *

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2. The respondent American Telephone & Telegraph Co. owns the patents. Amplifiers having these inventions are used in different fields. One, known as the commercial field, includes talking picture equipment for theaters. Another, called the private field, embraces radio broadcast reception, radio amateur reception, and radio experimental reception. The other respondents are subsidiaries of the Telephone Company and exclusive licensees in the commercial field of recording and reproducing sound; during the time of the infringement alleged, they were engaged in making and supplying to theaters talking picture equipment including amplifiers embodying the inventions covered by the patents in suit. The petitioner also furnished to theaters talking picture equipment including amplifiers which embody the invention covered by the patents in suit. Respondents' charge is that by so doing petitioner infringes them.

The American Transformer Company was one of a number of manufacturers holding non-exclusive licenses limited to the manufacture and sale of the amplifiers for private use, as distinguished from commercial use. These licenses were granted by the Radio Corporation, acting for itself and the respondent Telephone Company, and

were assented to by the latter. The Transformer Company's license was expressly confined to the right to manufacture and sell the patented amplifiers for radio amateur reception, radio experimental reception, and home broadcast reception. It had no right to sell the amplifiers for use in theaters as a part of talking picture equipment.

Nevertheless, it knowingly did sell the amplifiers in controversy to petitioner for that use. Petitioner admits that the Transformer Company knew that the amplifiers it sold to petitioner were to be used in the motion picture industry. The petitioner, when purchasing from the Transformer Company for that use, had actual knowledge that the latter had no license to make such a sale. In compliance with a requirement of the license, the Transformer Company affixed to amplifiers sold by it under the license a notice stating in substance that the apparatus was licensed only for radio amateur, experimental and broadcast reception under the patents in question. To the amplifiers sold to petitioner outside the scope of the license, it also affixed notices in the form described, but they were intended by both parties to be disregarded.

Petitioner puts its first question in affirmative form: "The owner of a patent cannot, by means of the patent, restrict the use made of a device manufactured under the patent after the device has passed into the hands of a purchaser in the ordinary channels of trade and full consideration paid therefor." But that proposition ignores controlling facts. The patent owner did not sell to petitioner the amplifiers in question or authorize the Transformer Company to sell them or any amplifiers for use in theaters or any other commercial use. The sales made by the Transformer Company to petitioner were outside the scope of its license and not under the patent. Both parties knew that fact at the time of the transactions.

There is no ground for the assumption that petitioner was "a purchaser in the ordinary channels of trade."

The Transformer Company was not an assignee; it did not own the patents or any interest in them; it was a mere licensee under a non-exclusive license, amounting to no more than "a mere waiver of the right to sue." *De Forest Co.* v. *United States*, 273 U. S. 236, 242. Pertinent words of the license are these: "To manufacture . . . and to sell only for radio amateur reception, radio experimental reception and radio broadcast reception. . . ." Patent owners may grant licenses extending to all uses or limited to use in a defined field. *Rubber Company* v. *Goodyear*, 9 Wall. 788, 799-800. *Gamewell Fire-Alarm Telegraph Co.* v. *Brooklyn*, 14 Fed. 255. *Dorsey Rake Co.* v. *Bradley Co.*, Fed. Cas. No. 4,015, 7 Fed. Cas. 946, 947. Robinson on Patents, §§ 808, 824. Unquestionably, the owner of a patent may grant licenses to manufacture, use or sell upon conditions not inconsistent with the scope of the monopoly. *Bement* v. *National Harrow Co.*, 186 U. S. 70, 93. *United States* v. *General Electric Co.*, 272 U. S. 476, 489. There is here no attempt on the part of the patent owner to extend the scope of the monopoly beyond that contemplated by the patent statute. Cf. *Carbice Corp.* v. *American Patents Corp.*, 283 U. S. 27, 33. *Leitch Mfg Co.* v. *Barber Co.*, 302 U. S. 458. There is no warrant for treating the sales of amplifiers to petitioner as if made under the patents or the authority of their owner. R. S. §§ 4884 and 4898 (35 U. S. C. §§ 40 and 47). *Moore* v. *Marsh*, 7 Wall. 515, 521. *Waterman* v. *Mackenzie*, 138 U. S. 252, 256. *Gayler* v. *Wilder*, 10 How. 477, 494. *United States* v. *General Electric Co.*, *supra*. Robinson on Patents, §§ 762, 763, 792, 806 *et seq.*

The Transformer Company could not convey to petitioner what both knew it was not authorized to sell. *Mitchell* v. *Hawley*, 16 Wall. 544, 550. By knowingly making the sales to petitioner outside the scope of its

license, the Transformer Company infringed the patents embodied in the amplifiers. *Rubber Co.* v. *Goodyear, supra. Bement* v. *National Harrow Co., supra. United States* v. *General Electric Co., supra. Vulcan Mfg. Co.* v. *Maytag Co.*, 73 F. (2d) 136, 139. *L. E. Waterman Co.* v. *Kline*, 234 Fed. 891, 893. *Porter Needle Co.* v. *Nat. Needle Co.*, 17 Fed. 536. Petitioner, having with knowledge of the facts bought at sales constituting infringement, did itself infringe the patents embodied in the amplifiers when it leased them for use as talking picture equipment in theaters. *Mitchell* v. *Hawley, ubi supra. American Cotton-Tie Supply Co.* v. *Bullard*, Fed. Cas. No. 294, 1 Fed. Cas. 625, 629, 630. See Robinson on Patents, § 824. See *Holiday* v. *Mattheson*, 24 Fed. 185, 186. *General Electric Co.* v. *Continental Lamp Works*, 280 Fed. 846, 851. As petitioner at the time it bought the amplifiers knew that the sales constituted infringement of the patents embodied in them, petitioner's second question, as to effect of the license notice, need not be considered.

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IN THE

Supreme Court of the United States

October Term, 1937

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

PETITION FOR REHEARING.

SAMUEL E. DARBY, JR.,
EPHRAIM BERLINER,
Counsel for Petitioner.

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WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

PETITION FOR REHEARING.

Petitioner respectfully petitions for a rehearing of this case.

It does so because the opinion of the Court in effect upsets the law announced and consistently followed by this Court in a number of cases for approximately one hundred years, without expressly overruling that law and without differentiating therefrom. The result of the decision involves not only a grave injustice to the petitioner and the destruction of its business, but it has reestablished the expressly overruled doctrine of *Henry* v. *Dick*[1] in patent cases, with a scope so far greater than was there announced

[1] 224 U. S. 1.

as to be a matter of vital public interest and importance. Indeed, so far reaching are the implications of the decision that it became the subject of extended reference in the financial and general press of the country.

It is respectfully submitted that if the decision remains unaltered it will not only offer to those so disposed an avenue of escape from the prohibitions of the anti-trust laws, but will again unsettle and surround with doubt the question as to the limits of the patent grant with respect to the rights of purchasers of patented articles, which, until this decision, seemed to have been put at rest by a progressive and consistent series of decisions culminating and reviewed in the *Boston Store* and first *Shoe Machinery* cases.[2]

The Court, in its decision, apparently lost sight of the fact that this is an ordinary patent infringement suit. Since the earliest days of this Court's consideration of patent questions it committed itself to the interpretation of the patent statute that a patent owner could part with one or more of the exclusive privileges conferred upon him by a patent grant on such terms and conditions as he might exact and the purchaser or licensee be willing to assume. Early in patent litigation history, patent owners sought to impose conditions to the sale or licensed manufacture or use of patented articles. Those conditions ran the gamut of place of use, time of use, materials used, and resale price. Clearly, there was nothing *unreasonable* in any of these requirements exacted by the patent owner as a condition to the sale of a patented article or a license to others to make, use or sell it. However, this Court, in a continuous line of authorities—

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[2] *Boston Store* v. *American Graphaphone Co.*, 246 U. S. 8; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32.

broken but once by its decision in *Henry* v. *Dick*,[3] which was then promptly overruled—held that these conditions could not be enforced against *purchasers*. This line of authorities includes the recent *Carbice* case[4] and the *Barber Asphalt* case[5] decided this present term. In none of these decisions was it held that the condition of sale was unreasonable or violative of some law. Each decision, in principle, and some of them expressly, was founded on the proposition that the *sale* of a patented article *exhausted the monopoly conferred by the statute and forever freed that article from the monopoly of the patent under which it had been sold.*

Now, however, the Court having before it what is perhaps the last or only remaining attempted restriction, namely the *manner or purpose of use* of the patented article sold, by its present decision sanctions such a restriction on the patented article *after its sale*. Thus, though as above stated, under the many prior decisions of this Court *no* restriction may be placed by a patentee on an article sold under the patent with respect to its place of use, its time of use, the materials used with it, or its resale price, the patentee may now control its *manner or purpose of use* throughout its useful life.

In reaching this decision, the Court has apparently overlooked the fact that there is no distinction in principle between any of these restrictions; and this is emphasized by the failure of the Court in its present decision in this case to distinguish the restriction here attempted, in principle or in law, from the other restrictions which this Court has consistently invalidated.

Thus, under the present decision of the Court in this case, one who purchases a patented lighter in any cigar

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[3] 224 U. S. 1.
[4] 283 U. S. 27.
[5] 302 U. S. 458; 82 L. Ed. 276.

store in the country for the stated purpose of lighting cigars, which lighter contains a notice thereon and thereby conveys knowledge to the purchaser that it is licensed by the patentee to light only cigarettes, would be guilty of infringing the patent if the lighter were used to light a cigar, and the retailer would have made an illegal sale. This same analog, given in our main brief (pp. 13-14) was swept aside by counsel for respondent at the argument of the case, *not* because it was *inapplicable*, nor because it was *unsound*, but solely because it was "extreme". We admit that it *is* extreme, but the point is that it is *legal* under the Court's present decision, and it fittingly illustrates the extremes to which patent owners may now go under the Court's decision in this case, as well as the inevitable far reaching consequences thereof.

Thus, by the Court's decision in this case, every patent owner is empowered, merely by a notice attached to a patented article, to control the manner or purpose of use of the article by the purchaser. Fountain pens may be sold only for signing letters; electric lamps only for private use; automobiles only for commercial use. Similar analogs, unlimited in number, can be readily drawn. It was undoubtedly because of these considerations, in previously arriving at a conclusion directly opposite to that arrived at by the majority in the present case, that this Court said:[6]

> "The inconvenience and annoyance to the public that an opposite conclusion would occasion are too obvious to require illustration".

At the outset, therefore, it is submitted that the question presented by this case is of such far reaching effect and of

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[6] *Keeler v. Standard Folding Bed Co.*, 157 U. S. 659, 667.

such great public importance as to warrant this Court granting a rehearing by a full bench.

The Court puts its opinion squarely on the proposition that the *sales by the licensee* were outside the scope of the license, and an infringement because the licensee and petitioner *knew* that the *use* to which the amplifiers were to be put was not one of the permitted uses specified in the license and on a restrictive use notice that the licensee, in accordance with his contract with the patentee, had affixed to the articles before they passed into the hands of the petitioner as purchaser.

It is submitted that this conclusion is erroneous on principle, wholly unsupported by authority and, indeed, contrary to the clear import of many decisions of this Court, none of which appears to have been considered in the majority opinion.[7]

The primary issue here is not *knowledge* or *intention*. Knowledge of some purported restriction, either expressed in the form of a notice, or implied in the limited grant to an assignee or licensee, necessarily appears in *every* case that ever came before this Court where a patentee sought to enforce the restriction against the purchaser of a patented article. Yet, in none of them did the patentee prevail. Indeed, in one instance the purchaser actually *agreed in writing* with the dealer-licensee to comply with the restriction sought to be imposed on the patented article, but was held by this Court to be free of the covenant;[8] and in an-

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[7] *Adams* v. *Burke*, 84 U. S. 453; *Hobbie* v. *Jennison*, 149 U. S. 355; *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659; *Bauer* v *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor*, 243 U. S. 490; *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502; *Boston Store* v. *American Graphaphone Co.*, 246 U. S. 8; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32.

[8] *Boston Store* v. *American Graphaphone Co.*, 246 U. S. 8.

other instance, *knowledge* of intention to use the patented article for purposes outside of the scope of the seller's right under the patent grant was held to be equally irrelevant.[9]

Nor is the issue here whether a patentee may reserve rights under a patent in dealings with a *licensee*, which is all that was held in the pertinent cases and text cited in the majority opinion.[10] The present controversy is concerned exclusively with the rights of *purchasers* of patented articles, and *not* with the relations between patentees and their *licensees*.

The sole question can be nothing more than the *validity* of the attempted restriction here. (See *Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373, 395.) If it is invalid it becomes utterly irrelevant to consider what the Transformer Company or the petitioner *knew* or *intended* to do about it. As Judge HOUGH put it, at the trial of the *Motion Picture Patents* case:[11]

> "* * * I apprehend that the question here is whether the Prague Amusement Co. could not do exactly what it is accused of having done, no matter how many conversations it had with the Patent Co., or any of its affiliated concerns. * * * The question is, was it lawful. That is the whole point."

The decisions of this Court leave no room for doubt that such attempted restrictions intended to attach to pat-

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[9] *Hobbie* v. *Jennison*, 149 U. S. 355. See pp. 36-38 of Petitioner's Brief.

[10] See *United States* v. *General Electric Co.*, 272 U. S. 476, in which it is indicated that even between licensor and licensee the reservations must of course be reasonable and not violative of general law.

[11] United States Supreme Court Record, pp. 54-55, in 243 U. S. 502.

ented articles *after their sale* are unenforceable under the patent law. Indeed, those cases have been twice held by this Court to lay down rules applicable to *all* types of restrictions, whether as to use, resale or otherwise. So, speaking of the effect of the *Motion Picture Patents* case, this Court stated [12] it had held:

> " • • • that, as by virtue of the *patent law,* one who had sold a patented machine and received the price, and had thus placed the machine so sold beyond the confines of the patent law, could not *by qualifying restrictions as to use,* keep under the patent monopoly a subject to which the monopoly no longer applied." [13]

And, in a later case, this Court held: [14]

> "Indeed, we said in the Paper Bag Patent case, that he (the patentee) may keep his invention out of use. Therefore, he necessarily has the power of granting it to some and withholding it from others, a right of selection of persons and terms. *There is, however, a limitation upon him; he cannot grant the title and retain the incidents of it*: *Straus* v. *Victor Talking Machine Co.* 243 U. S. 490; *Bauer* v. *O'Donnell* 229 U. S. 1; *Motion Picture Patents Co.* v. *Universal Film Co. supra.*
>
> These cases have received review and application in *Boston Store of Chicago* v. *American Graphaphone Co.* 246 U. S. 8. The principle of them was expressed to be that *where an article has been sold it passes beyond the monopoly given by the patent and conditions cannot be imposed upon it.*" (Matter in parenthesis ours.)

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[12] *Boston Store* v. *American Graphaphone Co.*, 246 U. S. 8 at p. 25.

[13] Italics in this brief ours, unless otherwise stated.

[14] *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32 at p. 58.

The majority opinion in the case at bar does not distinguish these cases. It does not even mention them. It does not question that the Transformer Company was licensed to make and sell the amplifiers, and that it affixed the restrictive notices required by the agreement to be affixed to the amplifiers on their sale. Nor does it question the fact of sale,[15] nor that *title* to the amplifiers passed to the petitioner. Neither does the opinion concern itself with the effect of these "notices", the only source of knowledge of purported restrictive use intended by the patentee to be given by the Transformer Company to purchasers of the amplifiers. The parties to the agreement so understood it and the agreement itself so expressly provided.[16]

Had the majority opinion considered the "license notices" it would have been met with the Court's own holding in the *Motion Picture Patents* case, where, in referring to the issues "arising with increasing frequency * * *" as to whether a patentee by notice can prescribe "the con-

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[15] Petitioner and respondent stipulated at the trial that the amplifiers in suit were made and *sold* by the licensee to the petitioner (Vol. I., fol. 194).

[16] (a) In a letter to petitioner, the Transformer Co. wrote: "That is the type of license notice which is placed upon the amplifier and that is the only way which we can sell them". Vol. II, p. 732, fol. 2195.)

(b) In a letter to the licensee, answering an inquiry as to the "notice", the licensor wrote: "The net result of this is that if *anyone buys* an * * * amplifier unit from you he may use it for a radio receiving set but he cannot use it for an electric phonograph * * *" (Vol. II, p. 1214, fol. 3642). See also par. 5 of the license agreement (Vol. III, p. 1418, fols. 4253-4254).

ditions of its use", on the *sale* of a patented article, this Court said:[17]

> "The statutes relating to patents do not provide for any such notice and it can derive no aid from them."

If, therefore,—as this Court *has* repeatedly held, and by this decision does not question—conditions cannot attach *under the patent law* to patented articles after their *sale, i. e.,*—that they cannot be enforced in an *infringement* suit *whatever* may be the remedy under contractual engagements,[18] no principle of law or of logic will make the purchaser an infringer because there is an *intention* to disregard those conditions.

If, as this Court holds, the *sale* to the petitioner was beyond the scope of the license because the licensee and the petitioner *knew* the article would thereafter be *used* for purposes other than those specified in the "notice" affixed to the article when sold, we can but repeat from our notes the question asked of respondents' counsel on argument by Mr. Justice STONE: "If the *sale* was *illegal*, then even a use by the purchaser *under the license notice* would be bad?" The question remained unanswered, but it points unerringly to the fallacy in the entire line of reasoning that led to the conclusion reached in the majority opinion.[19]

It is obvious that petitioner, in purchasing from the American Transformer—the licensed manufacturer—could

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[17] *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502 at p. 509.

[18] *Radio Corporation of America* v. *DeForest Radio & Telegraph Co.*, 97 N. J. Eq. 37. See also Note 17.

[19] See Petitioner's Brief, pp. 34-38; and Petitioner's Reply Brief, pp. 5-10, where the error in the "scope of license" theory is treated at length.

have advised the manufacturer that the amplifiers were to be used for the restricted licensed purpose, or for the unlicensed purpose, or could have remained mute as to the intended use thereof. Even under this Court's decision, in two of such cases the sale would have been *legally* made by American Transformer, but in all three of such cases if the amplifiers had been used in motion picture equipment, petitioner, under the Court's decision, would have been an infringer. This result follows not because the manufacturer's *sale* was an *illegal* one, or because of *knowledge* on the part of the manufacturer, but solely because of the *use* to which the purchased amplifiers were eventually put. The fallacy of the Court's opinion, as a matter of legal reasoning, is thus believed to be evident.

Another illustration fittingly shows the error of reasoning and conclusion in the majority opinion. The amplifiers with "notice" attached are sold in countless numbers across the counters of retail stores throughout the country. They were acquired from licensed manufacturers having license agrements with respondents identical in terms with that of Transformer Company—doubtless many of them from Transformer Company. Can it be questioned that under these circumstances the amplifiers were *legally* sold by the licensee to the retail store? If petitioner had purchased its amplifiers from the retailer for the stated purpose of using them in motion picture equipment, could it be correctly said that the sale by the manufacturer to the retailer and then by the retail dealer were illegal sales? Suppose petitioner had made *no* statement as to the purpose for which it intended to use the amplifiers. Would the sale by the manufacturer to the retailer and then by the retail store have been illegal sales? Suppose, again, petitioner had stated to the retail dealer that its intended use of the amplifier was

for the restricted use specified on the "notice" attached thereto. Would the sale have been an illegal sale? It is obvious that in all of these cases the *sale* was *legally* made by the manufacturing licensee to the retail store, and the *sale* was likewise *legally* made by the retail store to petitioner. Yet, in each case, under the present decision of this Court, if petitioner used the amplifiers, so bought from the retail dealer, in connection with motion picture equipment, petitioner would be an infringer. This again fittingly illustrates and conclusively shows that in the final analysis it is not a question of knowledge, intent, notice, or contractual limitation on the manufacturing licensee that determines whether or not an infringement occurs after a sale of the patented article. Quite to the contrary, *it is determined solely by the use to which the article is put.* And such use becomes the controlling factor, regardless of in whose hands the article may ultimately be found, and regardless of the number of hands through which it has passed by sale or gift. The absurdity of this result, which inevitably flows from the Court's present decision in this case, we are confident has not been considered by this Court, and alone should warrant and induce a rehearing.

Contributing to the error in the Court's decision, it is respectfully urged, are (1) a misapprehension of certain important facts which perhaps petitioner did not make sufficiently clear in its briefs; (2) a failure to recognize that once patented articles are sold, they become subject to the general law, and (3) that the rules of patent law developed by this Court as between patentee and licensee on the one hand, and patentee and purchasers of patented articles on the other, run in different channels so that what is applicable to one type of relationship is not necessarily, and, under the decisions of this Court, is definitely not applicable to the other.

To illustrate:

In two portions of the opinion it is stated that the amplifiers were not licensed to be sold for any commercial use. That is error. An inspection of the license agreement will demonstrate that purported licensed uses cover the field of "radio broadcast reception" unlimited, by express definition, to any private or "home" field.[20] Petitioner mentions this because the opinion states, as respondents urged in their briefs, though without support from the record, that respondents reserved the commercial field to themselves. What they really sought to do was to license the use of the amplifiers in amateur, experimental and in *certain* commercial fields, and to divide off and reserve *other* commercial uses to themselves and their associates under the radio pool agreements.[21]

There is equally grave error in the assumption by the Court that the Transformer Co. and petitioner both *knew* the sales were outside the scope of the license and that the licensee was not authorized to make them. The record is to the contrary. Though regrettably omitted from the briefs, it is in evidence that both parties acted on advice of counsel and in the honest belief that the Transformer Company had the right to make these sales and the petitioner to purchase.[22] *Mitchell* v. *Hawley*,[23] which the opinion cites as authority for invalidating these sales, is authority for petitioner and not for respondents. The licensee in that case

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[20] License Agreement, Vol. III, p. 1416, fol. 4248.

[21] Vol. III, pp. 1305-1413.

[22] Vol. I, pp. 368-370, particularly fols. 1108, 1109; fols. 1021-1022, referring to the letter exhibits in Vol. III at pp. 1563-1567.

[23] 16 Wall. 544.

was given *no power of sale whatsoever.* As the lower Court stated in that case:[24]

> "Nothing can be more evident than the purpose expressed in this instrument to put it out of the *power* of Bayley to give any title to the machines. The very act of sale was a violation of the contract and an act of infringement * * *" (italics by the Court).

In the case at bar, however, the power of sale *was* granted, and therefore petitioner acquired *valid title* to the amplifiers it purchased from the Transformer Company. The Court holds, nevertheless, that the very act of sale was an infringement, because of an *intention* to use the articles thereafter in a manner not permitted by the license that went with the article purchased. This basic error in assuming infringement by *intention,* as distinguished from the act of *unpermitted use* is believed to be grounded on a misapprehension of applicable legal principles.

Petitioner submits that if the patentee desires to secure to itself continued control over the *use* of the patented article in the hands of others, he may do so by *leasing* it upon suitable conditions, terminating the *lease* on breach of the conditions; or by selling it under *conditional* sale with proviso for reverter of title to the patentee on breach. But this is the only extent to which the patentee can deal with the article maintaining a control thereof after it has left his hands or those of his licensee to whom a *power of sale* was granted by agreement. If his licensee has allegedly breached any covenant with respect to this sale, the patentee is relegated to an action on the covenants *against the licensee alone,* without any continued right as against the

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[24] 11 Fed. Cases 883, at 885; affirmed 16 Wall. 544.

purchaser.[25] He cannot make a sale with the condition attached that the article shall be used or disposed of in a certain manner, leaving the title, as here, in the purchaser in case of a breach of the condition. Such a conditional sale would be an innovation in our system of jurisprudence, and if it should be permissible, sales of personal property could be disregarded by patentees on the plea that the patent monopoly secured to them a continued monopoly over the patented article, in spite of the general rules of law applying to the transfer of personalty.

Moreover, the Court made serious error upon which its conclusion was, in part at least, based, in asserting that petitioner, in the present case, was not "a purchaser in the ordinary channels of trade." To point out the error it is merely necessary to refer to the Court's prior decision in *Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373, 408, as authority for the proposition that any article sold becomes

> "an article of commerce and the rules concerning the freedom of trade must be held to apply to it."[26]

The authorities cited in the majority opinion as a basis for the conclusion of the Court intensify the grave error in finding infringement in the case at bar. Those authorities, including the references to *Robinson on Patents* (with

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[25] *Mitchell* v. *Hawley*, 11 Fed. Cases 883 at 885, aff'd. 16 Wall. 544.

[26] See also *Coca Cola Co.* v. *The State*, 225 S. W. 791, 793, where the Court said, of the status of a patented article after its sale,

> "Having parted with his ownership therein, it enters *the channels of trade* as an article of commerce, and is thereafter beyond his (the patentee's) control". (Matter in parenthesis ours.)

one or two minor and irrelevant exceptions), deal solely with the relations between *patentee and licensee,* and the broad reservations of rights permitted to patentees in such cases. The exercise of rights permitted to patentees in such instances rests upon principles utterly apart from those applied by this Court in cases, none of which it cited in the opinion here, involving the rights of *purchasers* of patented articles.[27] Patentees went to great pains in cases like *United States* v. *General Electric Co.*,[28] *Bement* v. *National Harrow Co.*,[29] *United States* v. *United Shoe Machinery Co.*[30] to convince this Court that they are not violators of the anti-trust laws, because, they argued, the transactions attacked were *not* sales of patented articles, but merely *license or agency* agreements which the patent monopoly protected so long as *purchasers* of the patented articles were not involved. This Court agreed with them, though in the *Shoe Machinery* case, the Government made a determined but unsuccessful effort to have the Court hold the leases of machinery to be sales, and so outside the scope of the patent laws. But *never,* until the decision in the case at bar (except in the expressly overruled *Dick* case and the cases predicated on the principle there stated), did this or any other Federal Court ever hold a purchaser of a patented article to be an infringer for disobeying, intentionally or otherwise, restrictive conditions sought to be annexed to the subsequent use or disposition of the article in the hands of the buyer. This, too, appears to be the gen-

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[27] See Petitioner's Reply Brief, pp. 14-18.
[28] 272 U. S. 476.
[29] 186 U. S. 70.
[30] 247 U. S. 32.

eral understanding of what this Court has heretofore held to be the law on the subject.[31]

The unfortunate result of this decision, therefore, is to brand as a knowing infringement and a tortious act,—for infringement is a tort,[32]—mere reliance on what this Court has held and repeated in decision after decision in the broadest possible terms. The Transformer Co. which sold the amplifiers to petitioner, with "license notice" restrictions attached, in exact compliance with its license agreement and after notification to petitioner that that is "the only way in which we can sell them",[33] is held to infringe respondents' patents, because it *knew* petitioner intended to disregard conditions *which this Court had heretofore held not binding on purchasers of patented articles.* And petitioner, likewise, is said to have infringed because it, too, *knew* that the licensee knew of petitioner's use of the amplifiers,—a use in strict accordance with counsel's advice that the attempted limitations on such use were illegal under the decisions of this Court. Petitioner cannot conceive on what principle of law or equity such conduct would constitute deliberate infringement.

Indeed, the grave error in this approach to the problem by the Court becomes evident from a consideration of what *respondents* knew of the alleged infringing sales. If knowledge or intent is to be a test, then the knowledge of all parties must be considered. Respondents having sought the aid of equity in instituting this infringement suit, must come into equity with clean hands. As Mr. Justice BUTLER

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[31] *Chicago Daily News* v. *Koehler*, 196 N. E. 445, 449-50; 1 *Walker on Patents* (1929) 425; 5 *Williston on Contracts* (1937) 4630-31; 41 *Harvard Law Review* 945, 1002; 24 *Ruling Case Law—Sales*—sec. 660.

[32] The *Carbice* case, 283 U. S. 27, 33.

[33] Vol. II, p. 732, fol. 2195.

recently pointed out [34] in quoting from an earlier opinion of this Court:

> "It is a principle in chancery, that he who seeks relief must have acted in good faith. The equitable powers of this Court can never be exerted in behalf of one who has acted fraudulently or who by deceit or any unfair means has gained an advantage. To aid a party in such a case would make this Court the abetter of inequity."

Viewed in the light of these principles, respondents' conduct cannot bear scrutiny. The very tenor of the license agreements they made with the Transformer Company and others for the making and sale of the amplifiers [35] and their conduct with respect to petitioner and the Transformer Company over a period of more than two years during which these sales were being made with full knowledge of respondents,[36] indicate most clearly a desire for extensive royalties by the wider market that comes with *sales* rather than simple *licenses* or *leases* to users, and an intention to rely on the efficacy of "license notice" restrictions alone, as attached to the articles. That is the tenor of the licensors' instructions on inquiry from the Transformer Company, written long before any transactions with petitioner.[37] That furnishes the sole logical and intelligible explanation why respondents, during the two years they concededly knew of the sales being made to petitioner by the Transformer Company, never protested; never returned the royalties they received on these very sales until more than a year after this

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[34] *Keystone Driller Co.* v. *General Excavating Co.*, 290 U. S. 240, 245, quoting from *Bein* v. *Heath*, 6 How. 228, 247.

[35] Vol. I, pp. 332-335; Vol. III, pp. 1414-1423.

[36] Vol. III, pp. 1568-1614.

[37] Vol. II, p. 1214, fol. 3642.

action was commenced; never sued the Transformer Company for any breach of the license agreement; never cancelled it; and permitted it to run until its natural expiration.[38] If those sales were "outside the scope of its license", as the majority opinion holds, a simple notice of cancellation would have effectually put an end to it. It is no answer to say a patentee may choose whom to sue amongst alleged infringers. This is not such a case because no infringement suit would have been required if respondents had honestly believed the Transformer Company was violating its contract by selling to petitioner, and had promptly acted accordingly.

Instead, respondents permitted the sales to continue without interruption, and although the bill herein was filed in 1929,[39] the sales, with the knowledge of respondents, continued to the expiration of the Transformer license agreement in August, 1931.[40] Indeed, this action was not brought to trial[41] until after a preliminary injunction had been granted[42] against respondents for violation of the antitrust laws with respect to the very business in which petitioner and respondents were competitors, and involving talking motion picture equipment that would be useless without the amplifiers purchased by petitioner from respondents' licensee.

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[38] Vol. I, pp. 344, 349, 468; Vol. II, p. 1216; Vol. III, pp. 1568-1614.

[39] Vol. I, fol. 1578.

[40] Vol. III, pp. 1568-1614.

[41] Vol. III, fol. 4854.

[42] *Stanley Co. of America, Inc.* v. *American Tel. & Tel. Co., General Talking Pictures Corporation* v. *American Tel. & Tel. Co., Duovac Radio Corporation* v. *American Tel. & Tel. Co.*, 4 Fed. Supp. 80; on final hearing 18 Fed. Supp. 650.

Such conduct surely does not warrant the interpretation given by this Court to the acts of the Transformer Company in selling, and petitioner in buying, the amplifiers in suit. Nor does it warrant what is in effect an overruling of the decisions of the Court for nearly a century that once *title* has passed to patented articles on a sale by a patentee or a licensee empowered to make and sell, those articles are freed of any and all restrictions on their use and disposition that the patentee may seek to have run with them in the hands of the purchaser.

There is, moreover, a further important aspect mentioned but not argued at length in the briefs or on oral argument and which, therefore, petitioner asks the Court to consider on this petition for rehearing, not alone because of the disastrous effect the decision, if unaltered, will have on petitioner, but on the public as well.

The patents which this Court has now found to be infringed were among those that formed the basis for a series of contractual engagements between respondents and the overwhelming majority of the leading motion picture producers and exhibitors in the United States, by the terms of which, it has been adjudged, respondents violated the anti-trust laws in establishing and continuing a monopoly with respect to equipment in which, as has been above noted, the amplifying devices with which this suit is concerned, are a material component part.[43] Petitioner and respondents, as parties to that suit, have both appealed—the petitioner because of the District Court's refusal to grant a permanent injunction due to respondents' statement that the practices complained of were stopped, though the contractual limitations which the Court found illegal were still

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[43] *General Talking Pictures Corporation* v. *American Tel. & Tel. Co.*, on final hearing, 18 Fed. Supp. 650; see Note 42, page 18.

in the agreements complained of, and the respondents from the holding of violation of the anti-trust laws.

Moreover, both in that anti-trust suit and in the case at bar, it appears that respondents' patents are included in patent pooling agreements commonly known as the Radio Trust,[44] discussed in the minority opinion but without reference to the authorities making such pools illegal if beyond the scope of the patent law, and therefore giving sufficient ground for this Court of its own motion,[45] the entire record being before it on certiorari,[46] where such illegality appears, to refuse to aid the claims of any patentee arising out of such agreements or other inequitable situations.[47]

In litigation that in many aspects closely paralleled the case at bar, and which, in its civil phase[48] petitioner asks this Court to consider as determinative of the fundamental error of the majority opinion herein, license agreements of the very type entered into between respondents and the Transformer Company, and based on a pooling of patents relating to motion picture apparatus, were held illegal and violative of the anti-trust laws.[49] Petitioner respectfully submits that there is no point of difference of any legal import between those cases and the one at bar except that in the Government suit in the *Motion Picture Patents* case

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[44] Vol. III, pp. 1305-1413.

[45] *Oscanyon* v. *Ams Co.*, 103 U. S. 261, 267.

[46] *Story Parchment Co.* v. *Paterson*, 282 U. S. 555.

[47] *Continental Wall Paper Co.* v. *Voight & Sons Co.*, 212 U. S. 227 at p. 262; *United States* v. *American Tobacco Co.*, 221 U. S. 106, 181; *Keystone Driller Co.* v. *General Excavating Co.*, 290 U. S. 240, at p. 245.

[48] *Motion Picture Patents Co.* v. *Universal Film Mfg Co.*, 243 U. S. 502.

[49] *United States* v. *Motion Picture Patents Co.*, 225 Fed. 800; appeal dismissed 247 U. S. 524; cited with approval in *Standard Oil Co.* v. *United States*, 283 U. S. 163, 174.

the patent pool was not nearly so extensive and not nearly so much of an unlawful encroachment on the business life and interests of the public, and that the adjudged illegality of that pool, and the adjudged invalidity of the restrictions sought to be imposed by the patentee, in that case, on purchases of the motion picture apparatus through the medium of licensees having the power to make and sell with such restrictions, should be conclusively determinative of the issues in the case at bar in favor of petitioner.

Conclusion.

We have endeavored to show by the foregoing that the question presented by this cause is of such scope and of such far reaching effect as to be of vital public importance. The majority opinion so materially upsets established doctrines of patent law that, for the foregoing reasons, the case should have the careful consideration of the full bench of this Court.

In consequence, petitioner respectfully and earnestly urges upon the Court this petition that the case be further heard.

SAMUEL E. DARBY, JR.,
EPHRAIM BERLINER,
Counsel for Petitioner.

We hereby certify that the foregoing petition for rehearing is, in our opinion, well founded, and that it is presented in good faith.

SAMUEL E. DARBY, JR.
EPHRAIM BERLINER

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FILED
MAY 26 1938
CHARLES ELMORE CROPLEY
CLERK

IN THE

Supreme Court of the United States

October Term, 1937

No. [redacted] 1

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

NOTICE OF MOTION, AND MOTION TO STAY MANDATE.

SAMUEL E. DARBY, JR.,
EPHRAIM BERLINER,
Counsel for Petitioner.

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IN THE

Supreme Court of the United States

October Term, 1937

No. 357

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

NOTICE OF MOTION TO STAY MANDATE.

To: MERRILL E. CLARK, Esq.,
Counsel for Respondents,
20 Exchange Place,
New York City, N. Y.

Sir:

PLEASE TAKE NOTICE that on Tuesday, May 31st, there will be presented to the Supreme Court of the United States

a motion to stay its mandate in the above entitled cause. A copy of the motion is hereto attached.

Yours, etc.

SAMUEL E. DARBY, JR.,
Counsel for Petitioner.

Dated: New York, N. Y.,
May 25, 1938.

Receipt of a copy of this notice and motion attached thereto acknowledged this day of May, 1938.

Counsel for Respondents.

IN THE

SUPREME COURT OF THE UNITED STATES,

OCTOBER TERM, 1937.

No. 357.

GENERAL TALKING PICTURES CORPORATION,
Petitioner,

vs.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS INC., and AMERICAN TELEPHONE AND TELEGRAPH COMPANY,
Respondents.

MOTION TO STAY MANDATE.

Now comes petitioner, and, representing that it is filing a petition for rehearing in this cause pursuant to the opinion of the Court rendered May 2nd, 1938, within the time permitted therefor by Rule 33 of the Revised Rules of this Court, moves that the mandate of this Court in this cause be stayed until the Court has passed on the petition for rehearing, and thereafter, if the petition for rehearing is granted, until the rehearing and determination by this Court are had.

Respectfully submitted,

GENERAL TALKING PICTURES CORPORATION,
Petitioner.

By SAMUEL E. DARBY, JR.,
Counsel.

Dated: New York, N. Y.,
May 25th, 1938.

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Respondents.

PETITION FOR REHEARING

SAMUEL E. DARBY, JR.,
EPHRAIM BERLINER,
Counsel for Petitioner.

JOSEPH J. ZEIGER,
Of Counsel.

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WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., and AMERICAN TELEPHONE & TELEGRAPH COMPANY,
Respondents.

PETITION FOR REHEARING.

Petitioner respectfully petitions for a rehearing in this cause.

The petition is predicated upon three grounds, as follows:

1. The decision of this Court, rendered November 21st, 1938, was to the effect that the two questions on which rehearing was had were not presented by the facts of this case and therefore need not be answered.

Though in arriving at this conclusion the Court assumed, and applied as a test, the enforceability of a limitation whose validity under the patent law was directly presented by the two questions which the Court nevertheless declined to answer, it is believed that the decision was largely induced by petitioner's failure, in its brief and on reargument, to point out the conclusively established and

undisputed facts which show that these questions *are* squarely presented. Petitioner failed to do this because it believed that when this Court ordered re-argument, the factual elements in the two questions were considered accepted and established, and because the prior decision of this Court in this case [1] apparently recognized that the first of the two questions, modified in the statement thereof, was properly presented and was answered.

It is also believed that this Court's present conclusion was arrived at on the theory that the amplifiers were manufactured solely for talking motion picture purposes and that therefore their sales to petitioner were outside of the Transformer Company license and hence infringing sales. In other words, this Court was apparently under the impression that the amplifiers were limited *in use*, to that purpose and were not *manufactured* under the license agreement because they were incapable of use for the uses specified by the license.

It is true that respondents took that position before this Court in their brief and on re-argument. It is equally true, however, that at no time prior thereto during this protracted litigation had respondents ever taken that position. In the first argument before this Court the contrary was expressly admitted (see respondents' brief and its reprint, p. 8). Moreover, and this is of controlling effect, the District Court made findings of fact directly contrary to respondents' present contention and to this Court's impression on which its decision was apparently based (Vol. III, pp. 1647; 1649; fols. 4939; 4945).

2. The present decision of this Court leaves undisturbed its prior decision in the case which did answer the first

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[1] 304 U. S. 175.

question in a manner at utter variance with many prior decisions of the Court and, without either expressly overruling them or differentiating therefrom.

3. Thus, the questions being properly presented by the facts and the record in this case, they should be answered in the negative in conformity with the decisions of this Court for nearly a century and for the reasons therein stated.

The majority opinion on rehearing cited *United States* v. *General Electric Company*[2] as authority for the proposition that a patentee may grant a license upon any condition, the performance of which is reasonably within the reward which the patentee, by the grant of the patent, is entitled to secure; and that the restriction here sought to be imposed by the patent owner was of the character referred to in that case, and was legal. By this, the Court could have meant only that the restriction was not inherently illegal as repugnant to the conscience or violative of some special statute, or, as the cases cited in the majority opinion clearly show, that it was enforceable where imposed solely as *a condition of use by a licensee*. In the same sense, restrictions on time of use, place of use, materials used, and resale price are "legal", but each and every one of them was held unenforceable under the patent law by this Court as against *purchasers* from patentees or those vested by patentees with a power of sale.

Petitioner at no time has contended, as the majority opinion of the Court implies, that the restriction here sought to be enforced by respondents is illegal in the general sense. Our contention has been, and the unanimous decisions of this Court, with the exception of the overruled *Dick* case,[3]

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[2] 272 U. S. 476, 489.
[3] 224 U. S. 1.

have been that all such restrictions are unenforceable *under the patent law* against purchasers of the patented article from patentees or those vested by patentees with a power of sale.

The remainder of this petition will be devoted to amplification and discussion of each of these grounds.

POINT I.

The facts in this case *do* present the two questions on which the rehearing was had.

This Court based its conclusion that the facts in the present case do not present the two questions for determination, on the ground that *both* the *manufacture* and *sale* of the amplifiers by the Transformer Company were outside the license under the patents; therefore, both *manufacture* and *sale* by the Transformer Company were infringing acts. It is believed that this Court was induced to that conclusion by the impression that the amplifiers so made and sold to petitioner were useful or capable of use *only* in the talking motion picture field, and were *not* useful or were incapable of use in the "licensed" field of radio broadcast, amateur and experimental reception. By no other reasoning could such a conclusion be arrived at when it is remembered that the restriction applies only to *use*, and only by user could it be determined whether there had occurred a violation of the restriction. The *facts* of the case, however, not only completely negative any such impression but they render illogical and erroneous the conclusion founded thereon.

Thus, it should be noted that the Transformer Company was possessed of the right to make *and* the right to sell. *It was granted no right to use.* There was no restriction of

any kind or nature imposed or sought to be imposed on the Transformer Company as to its right to *make*. The only restriction imposed or sought to be imposed by the license agreement was on the right to use the amplifier *after its sale*. This restriction in no way affected the Transformer Company for it was possessed of no license to use, in any event. The purported restriction, by its very terms and intent, was sought to be imposed upon *purchasers*, and to be made effective, not by *agreement* between the patent owner and the purchasers, *but by a mere notice attached to the amplifier*.

The foregoing is made clear by a consideration of the license agreement.

By paragraph 1 of the agreement the Transformer Company was given *an unqualified right to manufacture* at its factory and not elsewhere. This grant is set off from the rest of the paragraph by a semi-colon, an intervening phrase limiting the manufacturing to the licensee's premises, and by a comma. These are followed by a separate clause granting the right to *sell* the manufactured product "only for radio amateur reception, radio experimental reception, and radio broadcast reception".[4] Indeed, this restriction on *use after sale*, is not even separated by a comma from the grant of the right to sell, and, by the very language of the contract, limits *that* right and nothing else. Yet, the first majority opinion in this case links this restriction to the grant of the right to make, as well,[5] though there is nothing in the agreement or in any other part of the record to warrant it. The present majority opinion reads likewise, though in quoting from the agreement it separates the two grants by a comma, and omits the intervening phrase limiting the right to manufacture to the licensee's factory. But,

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[4] Vol. III, p. 1415, fol. 4245.
[5] 304 U. S. 175 at p. 180.

as we have hereinabove noted, and as correctly quoted in the present dissenting opinion, the grant of the right to *make*, unrestricted to any field of *use*, is clearly and unequivocally separated from the grant of the right to sell, by a semi-colon, the intervening phrase designating the place of manufacture, and by a comma.

That, too, was the practical construction put upon the agreement by the parties thereto long before petitioner was in existence. In a letter to the Transformer Company, the Radio Corporation, co-licensor with respondent Telephone Company, wrote in September of 1927:[6]

> "Your license permits you *to sell*[7] power supply and amplifier units for radio use only * * *.
>
> The net result of this is that *if anyone buys* an * * * amplifier unit from you, he may use it for a radio receiving set but he cannot use it for an electric phonograph * * *."

In other words, there was no restriction on use in the grant of the right to *manufacture*, for the simple reason that the Transformer Company was granted no right of user of the patented amplifier it made, but, by the terms of its agreement, it was permitted to *sell* only for the specified uses. That is how the agreement reads. That is the way in which the parties understood it. Moreover, that is the common sense of the situation. Even the Trial Judge in his opinion spoke of the amplifiers sold petitioner by the Transformer Company as—

> "the amplifying devices manufactured *under the patents*" (Vol. I, p. 1621, fol. 4859).

That was his *finding*.

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[6] Vol. II, p. 1214, fols. 3640, 3642.

[7] Italics in this petition ours unless otherwise stated.

Our first inquiry is, then, whether or not the amplifiers sold petitioner by the Transformer Company embodied the inventions of the patents. That they did, cannot be and is not disputed. The mere fact that petitioner has been sued for infringement of the patents precludes any but an affirmative answer to this inquiry. Thus, we have a situation where the challenged apparatus has been manufactured by one possessed of an unqualified and unrestricted right to manufacture it, and which apparatus undeniedly embodies the inventions of the patents in suit. Therefore, we fail to understand by what process of reasoning or by what legal principle this apparatus can be characterized as *not* manufactured "under the patents", and we believe that the foregoing simple analysis must inevitably point out to this Court its error in reaching such a conclusion.

The next question logically presented is whether or not, under such circumstances, the *sale* of the amplifiers was outside of the patents and constituted infringing sales, as concluded by the Court.

First we refer to the license agreement itself.

Paragraph 1 of the agreement[8] required the Transformer Company to sell only for the restricted uses enumerated immediately after the grant of the power of sale.[9] Paragraph 5 of the agreement particularized with meticulous detail precisely how such sales were to be made under such restrictions. No other reference to performance of

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[8] Vol. III, p. 1415, fol. 4245.

[9] Contrary to this Court's conclusions in both opinions, the commercial field *was not* reserved to respondents. What respondents really sought was to license the use of the amplifiers in amateur, experimental and *certain* commercial fields, and to divide off and reserve *other* commercial uses to themselves and their associates in the radio patent pool. This is evident from the Transformer Company agreement where the field of "broadcast reception" is, by express definition, unlimited to any private or home field (Vol. III, p. 1416, subdiv. (c), fol. 4248).

those conditions can be found elsewhere in the agreement. That paragraph required the Transformer Company to attach to each amplifier it made and sold, a plate reading:[10]

> "Licensed only for Radio Amateur, Experimental and Broadcast Reception."

The agreement contained no proviso requiring the Transformer Company to supervise or police the actual use of the amplifiers by the purchaser so as to assure itself that they were being used solely for the purposes specified on the "license notice". It was not even required to inform the licensors of the purchasers' names so as to give the patentees an opportunity to supervise for themselves if they so desired. Nor was the licensee asked or obliged to retain title or control by means of conditional sales agreements, or to exact agreements of any character from those who bought the patented articles it made and then sold with the "license notice" attached. All that the Transformer Company was required to do by its license agreement was to *sell* for the purposes stated in the "license notices", and the *method* which it was to adopt for that purpose was not only described in the contract but was the only one that the patentee, if making the sale directly, would have used, apart from making a specific contract with the purchaser. That is not only the fair and reasonable interpretation of the license agreement by its express terms and by the familiar rules of contract construction,[11] but it is precisely how the parties themselves understood and acted under it.

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[10] Vol. III, p. 1418; see also photograph of a typical "license notice" plate in Vol. II, p. 734.

[11] A license agreement is a simple contract and must be construed as such (*Wilson* v. *Sandford*, 10 How. 100). It is to be construed strictly against the party drawing it (*Moulor* v. *Amer. Life Ins. Co.*,

(Footnote continued on page 9)

No act of respondents in their dealings with the parties showed any indication that they considered the act of the Transformer Company in making the sale an infringement. Their concern was solely with the enforcement of the "license notice" restriction on *the subsequent use* of the articles after they had been sold.

When respondents' co-licensor, the Radio Corporation, wrote to the Transformer Company defining its rights and duties under the agreement, it did not say the *sales* would be infringements if the buyers of the articles used them contrary to the terms of the notice. It said that *if the purchases were made*, the *buyers* could not *use* them otherwise than as specified on that notice.[12]

If respondents had considered the *sale* to be the infringement, and a violation of the terms of the license agreement, would not the ordinary, prudent person, not to speak of an ever watchful great corporation, immediately have cancelled the license and instituted a suit for infringment against the infringing seller? Instead, what do we find?— (1) For a long period of time, even after knowledge of the use by petitioner, respondents continued to collect and retain royalties on those sales, and (2) they never protested to the Transformer Company that the sales were improper, but, on the contrary, permitted the license agreement to continue in full force and effect until the expiration of its term.

(Footnote continued from page 8)

111 U. S. 335), general terms therein must be held limited by the particular, giving due consideration, also, to grammatical construction and punctuation (*Joy* v. *St. Louis*, 138 U. S. 1; *Perry* v. *Mott Iron Works*, 207 Mass. 501, 93 N. E. 798), and the practical construction given to the contract by the parties must control (*Rubber Co.* v. *Goodyear*, 9 Wall. 788; *District of Columbia* v. *Gallaher*, 124 U. S. 505; *Lowrey* v. *Hawaii*, 206 U. S. 206; *Old Colony Trust Co.* v. *Omaha*, 230 U. S. 100).

[12] Vol. II, p. 1214.

As this Court held in *Rubber Co.* v. *Goodyear*:[13]

> "The practical construction which the parties themselves have given to a contract by their own conduct is, in cases of doubt, always entitled to great weight."

and, in words directly apposite here, continued:

> "If they had understood the license *then*, as they construe it *now*, their interest would have prompted an opposite line of conduct."

As respondents "*understood the license then*", they expected to have the courts enforce the "license notice" restriction on use as against those who *bought* the patented devices from the Transformer Company which was empowered absolutely to make them, and to sell them with that notice attached. That was the tenor and the practical construction of their license agreement. That is what respondents stood on and emphasized until they came to this Court. Had that notice restriction been enforceable *under the patent law*, respondents would have accomplished their purpose; no question of knowledge or intent as to the use to which the purchaser would put the articles could ever have arisen, and the acts of the purchaser in ignoring the "use restrictions" would have constituted infringement.

But this Court had given no indication in its prior decisions that such limitations on patented articles *after their sale* would fare any better than any of the other attempted restrictions which it held beyond the patent law, when sought to be enforced against purchasers. Indeed, this Court has twice held that those decisions laid down rules applicable to *all* types of restrictions.[14] And, in referring to the issues

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[13] 9 Wall. 788 at p. 799.

[14] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8 at p. 25; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32 at p. 58.

"arising with increasing frequency . . . ." as to whether a patentee by notice can prescribe "the condition of its use", on the *sale* of a patented article, this Court held:[15]

> "The statutes relating to patents do not provide for any such notice and it can derive no aid from them."

Therefore, faced by decisions holding that the "license notice" *method* which by the agreement they directed their licensee to use to impose the restriction, was unenforceable in patent law, whatever the contractual rights of the parties might be,[16] respondents "*construe it now*" as if the Transformer Company had violated its license by making the sale. But, as we have seen, that new construction accords neither with the language of the agreement nor with its practical construction by the parties. Nor does it accord with any principle of law or logic, or with any precedent we have been able to find.

How can a patentee impose on its licensee to make and sell, a condition on use *after sale* which the patent law does not recognize even if imposed by the patentee himself?

This Court has heretofore struck down every manner of restriction patentees tried to persuade it to enforce on patented articles *after their sale.*[17] If *such* conditions are not enforceable in infringement suits, by what manner of reasoning will *notice* thereof to anyone make them so. If un-

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[15] *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502 at p. 509.

[16] *Motion Picture Patents Co.* v. *Universal Film Co.* (*supra*); *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659.

[17] *Adams* v. *Burke*, 84 U. S. 453; *Hobbie* v. *Jennison*, 149 U. S. 355; *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659; *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor*, 243 U. S. 490; *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502; *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8; *United States* v. *United Shoe Machinery Co.*, 247 U. S. 32.

enforceable against purchasers when the device is sold by the patentee, on what conceivable theory do they become enforceable as a condition imposed on a right of sale by a licensee?

This Court must have overlooked the fact that respondents *under the guise of a right to subdivide* their patent right of user, are here seeking *to enlarge* the scope of that right by having this Court approve their effort to attach a condition of user intended to be effective *only after sale* of the patented article, and therefore utterly beyond the confines of the patent law, and falling directly within the prohibitions of the common law.[18]

In effect, therefore, in holding the Transformer Company's acts in making and selling to be infringements, this Court necessarily assumed the validity or enforceability *under the patent law*, of the condition *subsequent* imposed by the license agreement on the use of the amplifiers made and sold thereunder. The Court could not have reached that conclusion in any other way. In consequence, though the present majority opinion holds "that neither question should be answered", it takes for granted the very condition upon which were predicated the two questions ordered reargued, assumes what is called upon to be proven, and concludes with a determination that it does not have to pass upon it.

Therefore, we come to the final question logically presented, namely, were the amplifiers made and sold to petitioner capable of use for their "licensed" purpose? It is believed that this Court could not have arrived at the conclusion that the sales to petitioner by the Transformer Company of the challenged amplifiers were *infringing* sales unless it was

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[18] *Dr. Miles Medical Co.* v. *Park & Sons*, 220 U. S. 373.

of the belief that the amplifiers sold were useful only in the "unlicensed" field of talking motion pictures, and therefore were *incapable* of use in the "licensed" field of radio broadcast, experimental and amateur reception. Only by such reasoning could the *manufacture* of the amplifiers be termed "unlicensed". A careful study of this Court's last opinion makes it clear that the Court was under that impression, and that *by reason thereof* the Court concluded, in addition, that the sales to petitioner were not sales *in the ordinary channels of trade.* The facts and the law of the case completely negative the impression and the conclusion, as will now be shown.

For the first time in this or any of the courts below, respondents, in the argument leading up to the present decision, urged upon this Court the idea that the amplifiers in controversy were specially designed so as to be useful only with talking motion picture equipment.[19] The present opinion of this Court seems to be implicit with an acceptance of that thought. The facts, however, are otherwise. The Trial Court found that:[20]

> "• • • the circuit *could* function in the hands of defendant, as permitted by the terms of the notice attached to the amplifiers, namely for experimental or radio amateur use."

Again the District Court held:[21]

> "and the combination of the two elements constituting the amplifier *was capable of use* by a purchaser from the license *in fields to which the restrictions did not apply.*"

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[19] Respondents' Brief on Rehearing p. 5; footnote p. 14.

[20] Vol. III, p. 1647, fol. 4939. By stipulation the opinion of the District Court constituted the Findings of Fact and Conclusions of Law in the case (Vol. III, p. 1693).

[21] Vol. III, p. 1649, fol. 4945.

These findings of the District Court have never been disputed throughout the litigation, and should be treated as "unassailable".[22]

Moreover, it was stipulated at the trial that the licensee made and sold Types 25-A and A-41 amplifiers to petitioner.[23] Reports of those sales, introduced by respondents, showed that petitioner purchased large quantities of Type 25-A.[24] Attached to a letter put in evidence by respondents, in which the Transformer Company informed petitioner "That is the type of license notice which is placed upon the amplifier *and is the only way which we can sell them.*",[25] is a catalogue, showing Type 25-A as *a stock model.*[26]

If the amplifiers in controversy had not in fact been capable of various uses such as in wireless telephony, wire telephony, radio, public audition systems and sound systems generally, as respondents' expert testified they were,[27] what would have been the necessity of putting on each of them, as the Transformer Company concededly did,[28] license notice plates purporting to *limit* its uses to those specified on the notice?

This, too, was the understanding of the Vice President and Director of Patent Developments in the Radio Corporation of America, who testified on behalf of respondents as follows:[29]

> "These things, these vacuum tubes and the circuits on which we have patents, are useful in various of these fields and applicable to many fields. And if we

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[22] *Adamson* v. *Gilliland,* 242 U. S. 350.
[23] Vol. I, p. 65, fols. 193-194.
[24] Plaintiffs' Exhibit 77; Vol. II, p. 1225.
[25] Plaintiffs' Exhibit 33; Vol. II, p. 732, fol. 2195.
[26] Vol. II, last folded insert page marked 733 in blue printer's type.
[27] Vol. I, p. 194, fol. 581.
[28] Vol. I, p. 390, fol. 1168; Vol. II, p. 734.
[29] Vol. I, pp. 516-17, fols. 1548-1549; p. 518, fol. 1554.

> granted licenses not restricted to any particular field, *the same things could be used in these other fields.*"

That very admission was made by respondents' counsel, as well, and appears in their original brief to this Court (and its reprint on rehearing) at page 8.

This being so, there can be no question but that when the Transformer Company made the amplifiers in controversy, it made them capable of the *restricted* uses, so that when it sold them under its conceded power of sale, they continued to be capable of the same *restricted* uses specified on the "license notices" attached to them on sale.

Therefore, there can be no infringing sale because respondents' grievance, if any, could arise only *after sale*, and then only when and if the *purchaser* ignored the license notice by *actual use* of the amplifiers contrary to the restricted purposes thereon stated. This seemed clear to the Trial Judge who pointed out in his opinion:[30] "It is for use in *excluded* fields, that plaintiffs sue" (Italics by the Court). But under the view of respondents, which the present majority opinion appears to have accepted, we take it this Court would now have to answer in the affirmative, what respondents never did answer though asked by Mr. Justice STONE on the first argument:

> "If the *sale* was *illegal*, then even a use by the purchaser under the license notice would be bad."

The thought behind that question points unerringly to the fallacy in the entire line of reasoning that led to the conclusion reached in the present majority opinion.

There is equally no basis in fact or law for the conclusion in the present majority opinion that the amplifiers "did not

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[30] Vol. III, p. 1647, fol. 4940.

pass into the hands of a purchaser in the ordinary channels of trade".

The phrase "passed into the hands of a purchaser in the ordinary channels of trade" as it appears in the questions which were ordered reargued, is simply the language of the courts in defining transactions by which patented articles pass from one empowered to sell them, into the hands of purchasers who thereupon proceed to use them. There is no question but that the Transformer Company had the right to manufacture the amplifiers in controversy. There is no question but that it had the right to sell them. Until the decision in this case it was also thought beyond question that purchasers could properly ignore restrictive conditions purporting to be operative on patented articles *after their sale.* This Court so held in infringement suits concerned with sales by patentees,[31] by assignees[32] *and by licensees,* empowered as in the case at bar, to make and sell.[33]

This rule so developed and applied by this Court rests on no distinction amongst these three groups of cases.[34] Counsel thought so and so advised petitioner.[35] Leading students of the law thought so,[36] as did other Courts.[37]

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[31] *Adams* v. *Burke,* 84 U. S. (17 Wall.) 453; *Hobbie* v. *Jennison,* 149 U. S. 355; *Keeler* v. *Standard Folding Bed Co.,* 157 U. S. 659.

[32] *Bauer* v. *O'Donnell,* 229 U. S. 1; *Straus* v. *Victor Talking Machine Co.,* 243 U. S. 490; *Boston Store* v. *American Graphophone Co.,* 246 U. S. 8.

[33] *Motion Picture Patents Co.* v. *Universal Film Co.,* 243 U. S. 502; *Jackson* v. *Vaughan,* 73 Fed. 837, Circuit Court N. D. Cal.; *Hogue & Berrian Package Co.* v. *Bryan Wise,* 35 U. S. Pat. Q'ly 72; Dist. Ct. Michigan (unoff. reported, 1933).

[34] *United States* v. *United Shoe Machinery Co.,* 247 U. S. 32 at p. 58; *Boston Store* v. *American Graphophone Co.,* 246 U. S. 8 at pp. 25-26.

[35] Vol. I, p. 341, fols. 1021-1022; pp. 367-370, fols. 1108-1109.

[36] *5 Williston on Contracts,* pp. 4630-4631; Prof. Chafee in 41 Harv. Law Rev. 945 at 1002; 1 Walker on Patents (1929) at p. 425; 24 Ruling Case Law; Sales, pp. 372-373.

[37] See *Chicago Daily News* v. *Kohler,* 196 N. E. (Ill.) 445, 450.

Indeed, so intense and so firmly rooted is this conviction, upset as it now seems to be unless this Court will reverse its ruling, that a leading article in the current Columbia Law Review [38] and extensive notes in the current New York University Law Quarterly and North Carolina Law Reviews [39] urge the view that the decision in the present case, and the reasoning leading up to it, are erroneous on principle and precedent.

Surely such a situation cannot co-exist with an atmosphere of suspicion and "connivance" so sedulously worked up by respondents and which seems to pervade the opinion in this case, though unexpressed beyond the conclusion that petitioner was not "a purchaser in the ordinary channels of trade". That phrase is the language used by this Court when it stated that *any article sold* becomes: [40]

> "an article of commerce and the rules concerning the freedom of trade must be held to apply to it."

And, writing of the status *of a patented article after its sale,* another Court held: [41]

> "Having parted with his ownership therein, *it enters the channels of trade* as an article of commerce, and is thereafter beyond his (the patentee's) control." (Matter in parthenesis ours.)

Perhaps the origin of the expression, in so far as transactions of this character are involved, is found in a Circuit

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[38] 38 Columbia Law Review 1145 at pp. 1154-1158 and p. 1178 (Nov. 1938).

[39] 16 New York University Law Quarterly Review, pp. 160-162 (Nov. 1938); 17 North Carolina Law Review, pp. 74-78 (Dec. 1938).

[40] *Dr. Miles Medical Co.* v. *Park & Sons,* 220 U. S. 373 at p. 408.

[41] *Coca-Cola Co.* v. *The State,* 225 S. W. 791, 793.

Court opinion from which, because of the erroneous emphasis placed on the phrase in the present majority opinion, we quote at length:[42]

> "* * * I think all property stands upon an equal basis, whether that property consists of gold dollars in your pocket, real estate, or the ownership of a patent. There is no peculiar sanctity hovering over or attaching to the ownership of a patent. It is simply a property right, to be protected as such. Starting from that as a basis, while every property owner may determine for himself to what he will devote his property, yet *the moment he puts that property into what I perhaps may, for lack of a better expression, define as the channels of commerce, that moment he subjects that property to the laws which control commercial transactions;* just as in the warehouse cases (*Munn* v. *State of Illinois*, 94 U. S. 113), in which that court held that when an individual built a warehouse, and put his property into that kind of business, he subjected the property thus placed to the laws which controlled the transactions of commerce. * * * No man holding property was bound to build a warehouse, or bound to put his property into that particular channel, but the moment he did so, he put it * * * into the channels of commerce,—as multitudes are doing,—into the railroad business, into the express business, and into other channels of commerce. Whenever the property is put into those channels it is put within the power of the public, speaking through its legislature, or the power of the court enunciating general rules operative upon such transactions, to modify leases, modify licenses, control duties * * *."

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[42] *State of Missouri* v. *Bell Telephone Co.*, 23 Fed. 539 at p. 540; appeal dismissed 127 U. S. 780.

Summary and Conclusion as to the First Point.

It is therefore submitted that the two questions on which the reargument was ordered *and to which it was confined,* are squarely raised in the present case.

The Transformer Company was possessed of the unlimited and unrestricted right to *make.* The restriction on *use* sought to be effected on the patented amplifiers throughout their lives was not a restriction on the licensed *manufacturer.* On the contrary, it was a restriction sought to be imposed only on the *purchaser,* and by its very nature could be operative only against the *purchaser.*

Likewise, this restriction was not on the licensed manufacturer's right of *sale,* as is made evident by the license agreement itself, which imposed upon the licensee no obligation other than attaching the notice of restriction to the amplifiers when sold; it is made further evident by the practical construction given to the license agreement by the parties themselves, as is exemplified by correspondence and the operations of the Transformer Company over a long period of time without question or protest.

Finally, the conclusion of the Court that the questions were not presented by the facts of this case could have been arrived at only because of the belief that the amplifiers made and sold to petitioner by the Transformer Company could be used and were useful *only* in the talking motion picture field. Such is entirely contrary to the fact, and to the findings of fact of the District Court, which findings, fully supported by the evidence, had never heretofore been questioned.

It is submitted, therefore, that a rehearing should be granted and the two questions passed upon.

POINT II.

The present majority opinion of this Court leaves undisturbed the prior decision of the Court in this case.

Although the present majority opinion disposed of this case with the assertion that the two questions on which the rehearing was ordered are not presented by the facts, it leaves undisturbed the prior majority opinion of this Court which found that the first question, modifiedly stated, *was* presented by the case, and in effect answered it in the affirmative. In doing so, the first decision was at utter variance with the prior decisions of this Court, on the same issues of law involved, for nearly a century, and failed to expressly overrule them or in any wise to differentiate from them.

In consequence, while it was no doubt the purpose of this Court, by its current disposition of this case, to leave the questions presented unanswered, the prior and still outstanding decision in the case in effect answers the first and perhaps the most important question, and, like the present decision, is capable of being read, and *has* been read as reinstating the overruled doctrine of *Henry* v. *Dick*.[43]

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[43] 17 North Carolina Law Review 74, 78; 38 Columbia Law Review 1145, 1154-1158, 1178; 16 N. Y. U. Law Quarterly Review 160-162.

POINT III.

The two questions, being properly before this Court in this case, should be considered on reargument and answered in the negative because of the merits and the applicable law.

It is deemed to be unnecessary extensively to discuss the subject of the merits in this petition for a rehearing.

However, it is deemed important to call the attention of the Court to two vital elements it has apparently overlooked. They are (1) that the case at bar is in every essential the same as the *Motion Picture Patents* case;[44] and (2) that the principles and supporting cases referred to in the present majority opinion, concerning the validity of restrictive license conditions, are wholly inapplicable here. They are inapplicable because they relate solely to the relationship between licensor and licensee in situations where the separate and different questions as to limitations on rights of *purchasers* of patented articles, intended to be effective *after sale,* were neither involved nor considered.

In the *Motion Picture Patents* case, as here, the patent owner granted a license to *make and sell* under the patent. There, as here, the license to sell was restricted as to use, and it was sought to make the restriction effective by a *notice* attached to the patented device sold. There, too, the purchaser was sued *for infringement of the patent* because of failure to honor the restriction. There, as here, the patent owner contended that the *sale,* being outside of the restricted license was an *infringing sale,* the patented device an infringing device wherever found, and the *use* thereof

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[44] 243 U. S. 502.

in the hands of a *purchaser* an infringing use, and the purchaser an infringer.

The only distinction between the *Motion Picture Patents* case and the case at bar is that there the restriction on use was directed to materials to be used with the patented device, whereas here the restriction on use is directed to the *field* of use of the patented device. In the *Motion Picture Patents* case this Court held the restriction *unenforceable under the patent law.* In the case at bar, however, the effect of the Court's opinion is to hold the restriction *enforceable* under the patent law.

What is there in the present case to justify this departure from the unquestioned rule of decision in the *Motion Picture Patents* case? It cannot be in the *type* of restriction sought to be imposed on purchasers of patented articles to be effective after sale. The present opinion does not put it on any such ground nor does it distinguish the restriction here involved in principle or in law. Indeed, this Court has interpreted the *Motion Picture Patents* decision to stand for the doctrine that a patentee "could not *by qualifying restrictions as to use*", keep his patented machine subject to the monopoly of the patent, once it has been sold.[45]

We cannot believe that this Court intends to stand committed to a doctrine that restrictive conditions unenforceable under the patent law against purchasers from a *patent owner* may nevertheless be enforceable under the patent law against purchasers from *licensees* of a patent owner. Yet that is precisely the effect of the present majority opinion in the case, anomalous though it seems to be.

Likewise, examining the problem from the angle of "knowledge", of which the Court in its current opinion

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[45] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8 at p. 25.

speaks, it is again impossible to perceive what there is here to distinguish this case from all the other decisions in this Court where *knowledge* of a purchaser's intention to disregard restrictive use conditions attached to the patented article sold, was invariably and expressly held irrelevant.[46] Those cases were not limited to sales by patentees or assignees. The *Motion Picture Patents* case involved a sale by a licensee whose license to make and sell is more exacting than the one in the case at bar. *Knowledge* was unquestioned in that suit. The *purchaser* of the device knew of the restrictions; *the party supplying the film* knew of them; and the Trial Court, in foreclosing extended questioning as to the knowledge of the other parties, held:[47]

> "* * * I apprehend that the question here is whether the Prague Amusement Co. could not do exactly what it is accused of having done, no matter how many conversations it had with the Patent Co., or any of its affiliated concerns. * * * The question is, was it lawful? That is the whole point."

The Court, having swept aside the "infringing sale" contention in that case, which parallels ours at every point except as to the particular *type* of restriction involved, there would seem to be no reason in principle or on authority why that contention should have prevailed here.

If a condition is unenforceable under the patent law as against purchasers of patented articles, the medium employed by the patentee to carry that condition along until it reaches the purchaser does not sanctify the condition so as to make the sale "an infringing sale" merely because the manufacturing licensee *knew* in making the sale that the purchaser would disregard that condition in using the

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[46] *Hobbie* v. *Jennison*, 149 U. S. 355; *Bauer* v. *O'Donnell*, 229 U. S. 1; *Straus* v. *Victor*, 243 U. S. 490.

[47] *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502; at pp. 54-55 of the printed Record of that case in this Court.

article. *A fortiori*, if, as this Court has held without exception, *knowledge* by the buyer and *intention* to disregard the restriction are of no legal significance because *the patent law* will not enforce it on patented articles *after their sale*, surely *knowledge* by the manufacturing licensee of the purchaser's *knowledge* and *intent* can obviously have no greater significance.

There can be no question but what *any* restriction between a licensor and a licensee is lawful and enforceable, provided, of course, it is not violative of some special statute or against public policy. But this is not so because of the *patent law;* it is so because of common law. A breach of such a restriction is actionable, and the licensor may choose from his many remedies, such as specific performance, damages, or cancellation. But by no interpretation of the *patent statute* could that breach by a licensee be actionable in an infringement suit by the licensor *against a purchaser* from a licensee possessed of the right to make and sell.

The license agreement may well have provided an obligation on the part of the Transformer Company to obtain *an agreement in writing* from petitioner that it would not use the amplifiers in the talking motion picture field. A breach of such an agreement by petitioner might have been actionable *on the contract* by the Transformer Company, either alone, or for the benefit of the licensor. But by no interpretation of the patent statute could petitioner have been sued for *infringement* of the patents under which the amplifiers were made and sold.[48]

There can also be no question but that the present majority opinion of the Court was correct in holding that restrictions *imposed upon a licensee* by a patent owner have

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[48] *Motion Picture Patents Co.* v. *Universal Film Co.*, 243 U. S. 502 at p. 509.

been held enforceable under the patent law. But the outstanding distinction between those cases and the case at bar, which this Court has overlooked, is that those cases and the principles of law there applied were concerned solely with restrictions on the *licensee's right of user*, or with situations where the restrictions imposed on the licensee who had a power to make and sell, were by their very terms intended to be effective only *prior to sale*. Here, the restriction is sought to be imposed on a purchaser's use of the amplifiers *after sale*, and is *not* enforceable *under the patent law*. Every decision of this Court on the subject for nearly a century has so held, with the single exception of the overruled *Dick* case. Indeed, this Court considered the rule enunciated by those decisions so firmly established that, in the *Boston Store* case it expressly rejected any further attempts "judicially to correct doctrines which by reiterated decisions have become conclusively fixed".[49]

This was the very point on which the oft-cited *Mitchell* v. *Hawley* decision turned,[50] and yet no case seems to have been the subject of more confusion as to precisely what was there involved. In that case, the licensee, Bayley, was granted an exclusive license *to make and use* for a specified territory and for the remainder of the original patent term. But the grant conveyed *no power of sale whatsoever. That was retained by the patentee.* The licensee had therefore violated his right of user by attempting to exercise a right which the patentee had reserved, viz., the right to vend. The Circuit Court held:[51]

> "An examination of this contract shows clearly that it was carefully drawn by the parties to guard against such a result. Nothing can be more evident

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[49] *Boston Store of Chicago* v. *American Graphophone Co.*, 246 U. S. 8 at p. 26.

[50] 16 Wall. 544.

[51] *Mitchell* v. *Hawley*, 1 Holmes 42 at p. 44; aff'd 16 Wall. 544.

than the purpose expressed in this instrument to put it out of the *power* of Bayley to give any title to the machines. The very act of sale was a violation of the contract and an act of infringement * * * " (Italics by the Court.)

It is difficult to understand how the grant of the right *to make and use* alone (*Mitchell* v. *Hawley*) can be deemed equivalent in the patent law to the grant of the right *to make and sell* alone (the case at bar). Yet the present majority opinion apparently cites the *Mitchell* decision as conclusive against petitioner.

The fact that the *power of sale* granted to the Transformer Company obliged it to condition the use of the amplifiers it made and thereupon sold under that power, so as to limit the purposes to which the *purchaser* would put the amplifiers, did not make it any the less an authority to sell, within the decisions of this Court to which we have referred. Restrictive conditions never having been held good by this Court as against patented articles *after their sale*, such conditions do not become enforceable under the Patent Law as limitations upon a power of sale. The patentee deliberately chose this method so as to find a wider market but the patentee is not without the power to withdraw it forthwith or to cancel its agreement with the licensee or to sue the licensee at law on the covenants. But this Court has at no time other than in the present case ever permitted the patentee to use the special remedies of the patent law to spread its monopoly beyond its proper confines as delimited by this Court. This phase, too, was given consideration by the Circuit Court in *Mitchell* v. *Hawley* when it held:[52]

"He (the licensee, Bayley) never acquired the right to sell a single machine * * * Had he * * * possessed

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[52] 1 Holmes 42 at p. 44.

> the *power to sell* the patented machines, the purchaser would have acquired a title which would have been outside of the monopoly, and would have acquired the absolute right to use the machines during the extended term; and this notwithstanding any covenants Bayley might have made not to convey such a title. Under such circumstances, the patentee must have sought his remedy against Bayley *on his covenants.*'' (Matter in parenthesis ours.)

If the language of this Court in the *Mitchell* case is read, as it should be, in the light of the facts more detailed in their presentation in the Circuit Court opinion, there could be no uncertainty as to just what was there involved and precisely what the Court there decided. Yet *Mitchell* v. *Hawley* was relied on by both the majority and minority opinions in *Keeler* v. *Standard Folding Bed Company,*[53] in *Henry* v. *Dick,*[54] and, finally, in the case at bar.

The minority in the *Dick* case, in which the present Chief Justice HUGHES concurred, also held that the *Mitchell* decision was no authority for upholding restrictions on patented articles *after their sale,* because, one of the rights which the patent law grants to a patentee, viz.,—*the right to sell,* had been *wholly retained* and not granted to the licensee in that case.[55] The same distinction is recognized in the present dissenting opinion in the case at bar.[56] It was recognized, as well, in *Waterman* v. *McKenzie.*[57] But it seems to have been entirely overlooked and not even mentioned in the present majority opinion here.

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[53] 157 U. S. 659.
[54] 224 U. S. 1.
[55] *Henry* v. *Dick,* 224 U. S. 1 at p. 63.
[56] See continuation of Footnote 1 of present dissenting opinion on page 2 thereof.
[57] 138 U. S. 252 at p. 256.

Had the minority opinion in the *Keeler* case, and the majority opinions in the *Dick* case and in the case at bar, examined and given due consideration to the closer analysis of the facts in *Mitchell* v. *Hawley* as they appear in the Circuit Court opinion in that case, sufficient ground would have appeared to hold the sales in the case at bar to have been lawful sales and free from any claim of infringement.

Hence, when the present opinion cites *Mitchell* v. *Hawley* for the proposition that "a restrictive license is legal", and the *Rubber Company* and *Gamewell* cases for the statement that "the practice of granting licenses for a restricted use is an old one" it may be agreed that that is so. But those decisions relate solely to *uses* by the *licensee* in the *practice* of the patented invention, and are concerned only with those situations between patentee and licensee as may arise *up to the point of sale* of the article made under the patent, but *never beyond it*. That, too, is all that Robinson on Patents,[58] sec. 916 stands for, viz.: "Any use beyond the valid terms of a license is, of course, an infringement", as cited in the present majority opinion.

This same all-pervading fallacy in logic and definition appears when the present majority opinion cites *United States* v. *General Electric Company*[59] as further authority for its conclusion. That case was concerned only with *agencies to sell*, and with the validity of agreements between the patentee and its manufacturing licensee as to the prices at which the licensee shall sell the electric light bulbs it made. In other words, as this Court there held, if a patentee grants a *license* to make and sell, he may require the

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[58] The decisions of this Court subsequent to *Adams* v. *Burke* (84 U. S. 453), and the doctrines therein developed, that patented articles after their sale are freed from the monopoly of the patent, are of a period subsequent to the Robinson text, last published in 1890.

[59] 272 U. S. 476

licensee to "limit the selling by limiting the method of sale and the price".[60] But throughout the *General Electric* opinion unmistakable emphasis is laid by the Court upon the distinction we have made, namely, between limitations on *licensees* that spend their force *at the point of sale*, and those that are designed to become effective solely *after* sale.

That goes to the heart of the error in the case at bar. That is what this Court appears to have overlooked. Hence, when the present majority opinion quotes from the *General Electric* case that "the patentee may grant a licensee 'upon any condition the performance of which is reasonably within the reward which the patentee by grant of the patent is entitled to secure,' " the statement of principle need not be questioned, but it must be read and understood as there intended, and controlled by the facts there presented. The very next sentence after that quotation makes that clear. It reads:[61]

> " * * * It is well settled, as already said, that where a patentee makes the patented article and *sells* it, *he can exercise no future control over what the purchaser may wish to do with the article after his purchase. It has passed beyond the scope of the patentee's rights.*"

In such language this Court summarized what, until the decision in this case, had been considered correct doctrine.

In all cases where this Court struck down restrictions sought to be imposed on patented articles, which restrictions, by their very nature, could not become operative until *after sale*, three elements were present, viz.: (1) a power of sale, vested either in the patentee, assignee or licensee; (2) an exercise of that *right to vend;* and (3) the consequent pass-

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[60] 272 U. S. 476 at p. 490.
[61] 272 U. S. 476 at p. 489.

ing of title to the patented article sold. Any sales claimed to have been made in excess of that power, were held by this Court to be matters of special contract, and enforceable, if at all, in contractual actions on the covenants, but *not* in infringement suits.

When, in reaching this conclusion, the *Motion Picture Patents* case [63] cited *Keeler* v. *Standard Folding Bed Co.*,[63] this Court demonstrated that there was no distinction in the Court's mind between patentees, territorial assignees or limited licensees. It thereby also demonstrated that the *Motion Picture Patents* decision rested, not on the nature or type of restriction employed, but rather on fundamental principle of far-reaching importance and vital public interest. That principle, in the language of this Court,[64] is that the monopoly of the patent cannot:

> "be extended beyond the scope of that law or, in other words, applied to articles after they have gone beyond its reach."

This broad line of demarcation between cases typified by the *Keeler, Motion Picture Patents, Boston Store* decisions, and the case at bar, on the one hand, and the *General Electric Company* decision on the other, has been firmly drawn. This Court itself drew that line. Patentees, too, drew that line for they urged the distinction first, in *Bement* v. *National Harrow Co.*[65] and then in the *General Electric* case. Though these two cases were brought under the anti-trust laws, the patentees successfully argued that they were not violators of those laws because the transactions attacked *were not sales* of patented articles but merely

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[63] 243 U. S. 502 at p. 509.
[63] 157 U. S. 659, 666.
[64] *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8, at p. 26.
[65] 186 U. S. 70, 93.

license or agency agreements imposing *no* conditions intended to be effective against purchasers of patented articles *after sale.* The present decision, however, erases the line, as if to say the line never existed. And this holding follows closely on the heels of the decision of this Court, per Mr. Justice BRANDEIS,[66] in which the earlier enunciated doctrine[67] was reiterated, viz.: that a restriction there imposed on one licensed to sell was *unenforceable* against the licensee under the patent law. To reach that conclusion, this Court reasoned in the *Carbice* case:[68]

> "The attempt to limit the licensee to the use of unpatented materials purchased from the licensor is comparable to the attempt of a patentee to fix the price at which the patented article may be resold (citing *Bauer* v. *O'Donnell, Straus* v. *Victor* and *Boston Store* v. *American,* with a cf. to *Bobbs-Merrill* v. *Straus,* 210 U. S. 339). In both classes of cases, courts deny relief against those who disregard the limitations sought to be imposed by the patentee beyond the legitimate scope of its monopoly." (Matter in parenthesis ours.)

That view and the opinion in this case are irreconcilable. If the reasoning in the *Carbice* case is sound, and there is every basis in principle and judicial precedent to substantiate it, the decision in the present case constitutes a reversion to *Henry* v. *Dick,* and a repudiation, though unexpressed, of the doctrine so painstakingly evolved by this Court in the course of almost a century, whereby the utilization of patented articles after their sale was kept unfettered from the monopoly of the patent law.

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[66] *Leitch Manufacturig Co.* v. *Barber Co.,* 302 U. S. 458.
[67] *Carbice Corp.* v. *American Patents Development Corp.,* 283 U. S. 27.
[68] 283 U. S. 27 at p. 32.

Conclusion.

Petitioner therefore earnestly requests this Court to give renewed consideration to this cause and to grant petitioner a rehearing therein.

Respectfully submitted,

SAMUEL E. DARBY, JR.,
EPHRAIM BERLINER,
Counsel for Petitioner.

JOSEPH J. ZEIGER,
Of Counsel.

We hereby certify that the foregoing petition for rehearing is, in our opinion, well founded and that it is presented in good faith.

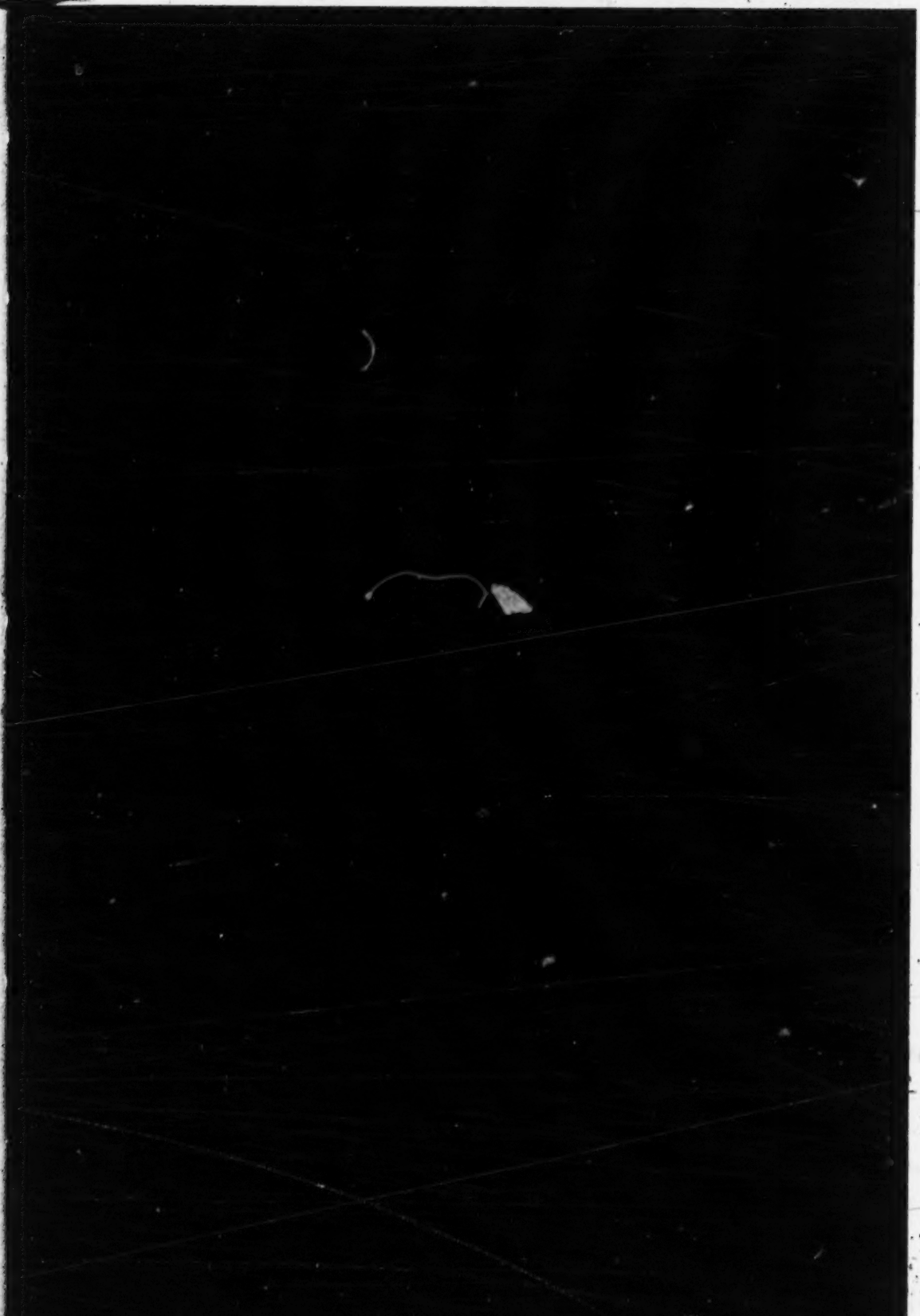
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In the Supreme Court of the United States

OCTOBER TERM, 1938

No. 1

GENERAL TALKING PICTURES CORPORATION, PETITIONER

v.

WESTERN ELECTRIC COMPANY, INC., ELECTRICAL RESEARCH PRODUCTS, INC., AND AMERICAN TELEPHONE AND TELEGRAPH COMPANY

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SECOND CIRCUIT

BRIEF FOR THE UNITED STATES AS AMICUS CURIAE

OPINIONS BELOW

The opinion of the District Court for the Southern District of New York (R. 1618) is reported in 16 F. Supp. 293. The opinion of the United States Circuit Court of Appeals for the Second Circuit (R. 1712) is reported in 91 F. (2d) 922.

JURISDICTION

The decree of the Circuit Court of Appeals was entered on October 27, 1936 (R. 1712). A petition

for a writ of certiorari was granted on October 11, 1937 (302 U. S. 674). The jurisdiction of this Court is invoked under Section 240 (a) of the Judicial Code as amended by the Act of February 13, 1925.

The cause was first heard by this Court on December 13 and 14, 1937, and an opinion was handed down on May 2, 1938 (304 U. S. 175). On May 31, 1938, this Court granted a rehearing on the first two questions stated in the petition for certiorari.

QUESTIONS PRESENTED

1. Can the owner of a patent, by means thereof, restrict the use made of a device manufactured under the patent, after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor?

2. Can a patent owner, merely by a "license notice" attached to a device made under the patent, and sold in the ordinary channels of trade, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device?

PRELIMINARY STATEMENT OF THE INTEREST OF THE UNITED STATES

The United States has no financial interest in this suit. The rule of law for which it contends, because of its limitation of the patent privilege, may appeal to neither party to the litigation. Yet, as representative of the public, the United

States has a substantial stake in the outcome. It is charged with the enforcement of the Sherman Act (15 U. S. C. Sec. 1–7) and the Clayton Act (15 U. S. C. Sec. 12–27) and a declaration of the validity of such a running restriction as is here at issue would put the administration of the antitrust acts in serious jeopardy.

The whole industrial system rests upon machine technology. It is an intricate aggregation of devices and processes. It depends upon the advance of science, is of very recent creation, and moves at a breathless pace. A concern must keep its technical processes up-to-date or fall behind in the competitive race. It is the rare invention which lives out its statutory span of seventeen years before it is succeeded by its better. Hence the vitality of inventions and discoveries inheres largely in the domain of "improvements"—under the aegis of the patent laws. The privileges granted by patents lie like a blanket over the whole intricate fabric of modern industry.

If a patent grant is limited to its proper orbit, the public policy embodied in the antitrust laws will be promoted. The constant referent for the limits of a patent will be its avowed constitutional purpose to "promote the progress of science and useful arts"; the scope of the rights of the patentee will be the legal permission to make, use, and vend given by the statute to implement the constitutional provision. The control by the owner over

the article which embodies his patent will be complete within this clearly defined constitutional and statutory domain; but it will cease with the disposition of the article by contract. Beyond this point the law governing transactions involving the article will be that declared by the common law and the applicable statutes. Thus the general law in respect to business will have its larger dominion, and the special exception granted to the inventor will have its clearly-defined province. Confusion as to the scope of the patent and antitrust laws will be avoided; an unwarranted extension of patent rights will not be permitted to nullify the antitrust acts; and a limited privilege for a particular purpose will not be allowed to render the law of the land inoperative.

But if the rights of the patent owners are allowed to be extended beyond the privilege to make, use, and vend, the whole matter becomes confused. Beyond this statutory limit it is not easy to draw any clear-cut line. A running restriction—such as restrictions upon time of use, place of use, and resale price—escapes the orbit of rights of the inventor and becomes interwoven with trade practices, methods of marketing, and the general usages under which all business is carried on. There the rights which inhere in a patent can be plead in extenuation of almost any restriction laid upon subsequent users or any burden of inconvenience imposed upon the public. And since patents per-

meate all technology, the threat is of legal sanction for a device which will exclude the competitive idea from one of the most important areas of American business and create an economic atmosphere in which the free play of individual enterprise is discouraged and restricted.

It is doubtless true that the United States by the prosecution of enforcement proceedings under the antitrust laws may be able to prevent and punish the more open and flagrant attempts to use the patent privilege to dominate industry and stifle competition. But as a practical matter, the encouragement of free enterprise and the preservation of the open market cannot be entirely left to preventive and punitive action by the law-enforcing branch of the government. Unless the private rights and obligations of men and of business units are governed by rules designed to encourage industrial freedom, the economic atmosphere may be such that governmental enforcement activities will be largely ineffective. Even spectacular victories in litigation instituted to enforce the antitrust laws are of no moment if men are to be free to make private arrangements which will thwart and nullify the public policy of these laws. Hence the importance of the instant case. It raises a crucial issue as to whether the content and incidents of private rights and obligations shall be consistent with the existence of private enterprise and a free and open market.

102067—38——2

In short, the government presents a brief in a private suit because it seeks to prevent a historic public policy, first established by the common law and now embodied in the antitrust acts, from being nullified by an extension of patent rights beyond their statutory limits.

ARGUMENT

I

A GRANT OF MONOPOLY IS AN EXCEPTION TO THE GENERAL LAW AGAINST RESTRAINTS IN TRADE. AS SUCH AN EXCEPTION THE PATENT PRIVILEGE SHOULD BE CONSTRUED STRICTLY

Free trade is the rule and monopoly the exception in our law; therefore the presumption is against any monopoly; its need in public welfare must be shown and cannot be assumed.

> That the King might make Corporations, and grant to them that they may make Ordinances for the ordering and government of any Trade; but *thereby they cannot make a Monopoly, for that is to take away Free-trade, which is the birthright of every Subject.* [Italics supplied.] *The Clothworkers of Ipswich Case,* Godbolt's Reports, 252, 253.

Similarly, in *Turner v. Winter,* 1 T. R. 602, 605, the Court said:

> I think that, as every patent is calculated to give a monopoly to the patentee, it is so far against the principles of law, and would be a reason against it, were it not for the advantages which the public derive from the communication of the invention * * *.

See also *Case of Monopolies,* 11 Coke 84 b.

The English and American Law of patents comes directly from a special exception for inventions in the Statute of Monopolies, 21 Jacob. I, c. 3, in 1623.

A patent is a limited monopoly granted for the ultimate purpose of developing the useful arts for the general public good. Although the means chosen to achieve this purpose give to the inventor the opportunity of pecuniary gain, the ultimate object of the law, nevertheless, remains the general good and not private advantage.

The power to grant patents is conferred by Article I, Section 8, of the Constitution, which authorizes the Congress "to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." As this Court said in *Kendall et al.* v. *Winsor,* 21 How. 322, 327–328:

> It is undeniably true, that the limited and temporary monopoly granted to inventors *was never designed for their exclusive profit or advantage;* the benefit to the public or community at large was another and doubtless the primary object in granting and securing that monopoly. This was at once the equivalent given by the public for benefits bestowed by the genius and meditations and skill of individuals, and the incentive to further efforts for the same important objects.

> The true policy and ends of the patent laws enacted under this Government are disclosed in that article of the Constitution the source of all these laws, viz: "to promote the progress of science and the useful arts," contemplating and necessarily implying their extension and increasing adaptation to the uses of society. [Italics supplied.]

Again in *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502, 510–511, this Court said:

> Since *Pennock* v. *Dialogue*, 2 Pet. 1, was decided in 1829 this Court has consistently held that the primary purpose of our patent laws is not the creation of private fortunes for the owners of patents but is "to promote the progress of science and useful arts" * * *

No one would contend that a patent grant is an unrestricted license to violate the antitrust laws. And when the patent laws have been construed as granting a broader exemption from these laws than Congress has deemed to be in the public interest, it has amended the antitrust laws so as specifically to restrict them. Thus the amendment of Section 3 of the Clayton Act in 1914 (15 U. S. C.) was intended to prohibit the practice sanctioned by the decision of this Court in *Henry* v. *Dick Co.*, 224 U. S. 1, in 1912.

The patent statute (35 U. S. C., Sec. 40) gives the inventor the exclusive right for the term of seventeen years "to make, use, and vend the invention or

discovery throughout the United States and the Territories thereof."

In *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502, 510, the scope of the grant was defined by this Court in these words:

> It has long been settled that the patentee receives nothing from the law which he did not have before, and that the only effect of his patent is to restrain others from manufacturing, using or selling that which he has invented. The patent law simply protects him in the monopoly of that which he has invented and has described in the claims of his patent. *United States* v. *American Bell Telephone Co.*, 167 U. S. 224, 239; *Paper Bag Patent Case*, 210 U. S. 405, 424; *Bauer* v. *O'Donnell*, 229 U. S. 1, 10.

A license is a mere permission granted by the patentee, a "mere waiver of the right to sue." *DeForest Co.* v. *United States*, 273 U. S. 236, 242. License agreements, therefore, are matters outside the patent law and subject to the general law. *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502. Accordingly, "patent pools * * * are not within the patent laws at all but arrangements for the purpose of forgetting about the patents." Workman, *Patent Pools in Relation to Patent Laws*, 13 A. B. A. J. 585, 587.

Therefore any rights asserted to arise from patent pools or cross-licensing agreements, are subject to the antitrust statutes.

II

Over a Period of Years the Respondents, in Concert With Others, Have Attempted to Secure a Broad Monopoly by Restrictive Contracts, Similar to Those Involved in the Instant Case

The defendant below and petitioner here is General Talking Pictures Corporation. The plaintiffs below and respondents here are the American Telephone and Telegraph Company (hereinafter referred to as the "Telephone Company"); its subsidiary, Western Electric Company (hereinafter referred to as "Western"); and Electrical Research Products, Inc. (hereinafter referred to as ERPI) a wholly owned subsidiary of Western. These three companies instituted this litigation seeking an injunction and an accounting for the infringement of patents covering vacuum tube amplifiers.

All of the patents but one were applied for by persons who assigned their rights to Western; Western, in turn, assigned them to the Telephone Company. The exception, the Lowenstein patent, was assigned directly to the Telephone Company. Thus, at the time of the trial the Telephone Company had title to all the patents. It had issued exclusive licenses to Western and ERPI to manufacture and sell the amplifiers for use in the motion picture field.

By a pooling, or cross-licensing arrangement, the Telephone Company authorized Radio Corporation of America (hereinafter referred to as "RCA") to issue licenses under these and other patents. RCA granted a license to the American Transformer Company. The license was restricted as to permissible use, permitting the licensee "to manufacture * * * and to sell, only for radio amateur reception, radio experimental reception and radio broadcast reception * * *" (R. 1414–1415). The purpose of this restrictive provision was to withhold from the licensee the right to manufacture and sell the amplifier for use in the motion picture field.

The American Transformer Company made amplifiers and sold them to the General Talking Pictures Company, the petitioner herein, which used them as part of the sound picture equipment which it leased to theaters. The infringement alleged in the bill of complaint consisted of the actions of the vendee, General Talking Pictures Company, in using the apparatus, and in leasing it to others for use, for purposes outside the restrictions contained in the license to the vendor, American Transformer Company.

This controversy is an incident in the struggle for control of the amplifier field. The conflict has been in progress almost since the invention of the vacuum tube, and it has been marked by a series of

investigations and lawsuits.[1] The apparent subject matter of controversy has sometimes been the intercorporate relationships of the interested parties; sometimes it has been pooling agreements or tying contracts. Sometimes, as in this case, the conflict takes the form of a suit for patent infringement. But whatever the superficial form, the basic issue is always the same—control over the amplifier field. The prize of every skirmish has been the

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[1] The main background appears in the record in this case where the principal licensing agreements are set forth (R. 743–792; 1305–1413). Subordinate arrangements, including the licenses to manufacture in issue herein are printed in R. 1414 *et seq.*; R. 734. Other details of the story are matters of public record. See Proposed Report, Telephone Investigation, Federal Communications Commission (1938), particularly chapters 7, 8, 13, and 14; Federal Communications Commission, Report on Electrical Research Products, Inc., pursuant to Public Resolution No. 8, 74th Congress; Hearings before the Committee on Patents, House of Representatives, 74th Congress, 2d Sess. (1935), on H. R. 4523, "Pooling of Patents," particularly pages 228–260, 262 *et seq.*, 997 *et seq.*, 1020 *et seq.*, and Appendix, giving copies of all the important agreements in three extensive parts, from pages 1199 to 3887.

The pooling agreements have often been the subject of litigation. See *United States* v. *Radio Corporation*, leading to stipulation and consent decree under the antitrust laws, 3 F. Supp. 23 (1932), R. 798–799; *Radio Corporation* v. *Lord*, 24 F. (2d) 565; *aff'd*, 28 F. (2d) 257; *cert. denied* 278 U. S. 648; on final hearing, 35 F. (2d) 962; *aff'd*, 47 F. (2d) 606; *cert. denied* 283 U. S. 847.

A suit wherein the basic licensing agreements were held to violate the antitrust laws is still in litigation; in *General Talking Pictures* v. *American Telephone & Tel. Co.*, 4 F. Supp. 80; on final hearing 18 F. Supp. 650; now on appeal to the Circuit Court of Appeals for the Third Circuit.

group of patents covering the vacuum tube, its manufacture, and its circuits.

An idea of the value of the interests at stake can be gathered from the chart reproduced on the following page.[2] It reveals the vacuum tube amplifier as the key to a vast number of technologies, profitable to those who control them, vital to the public. The three-element vacuum tube is the heart of the present electrical industry. The dissemination of news, the broadcasting of entertainment, the transmission of images (television) by wire and wireless, the talking motion picture, and the operation of diathermy machines for healing the ill all involve the vacuum tube as a necessary factor.[3]

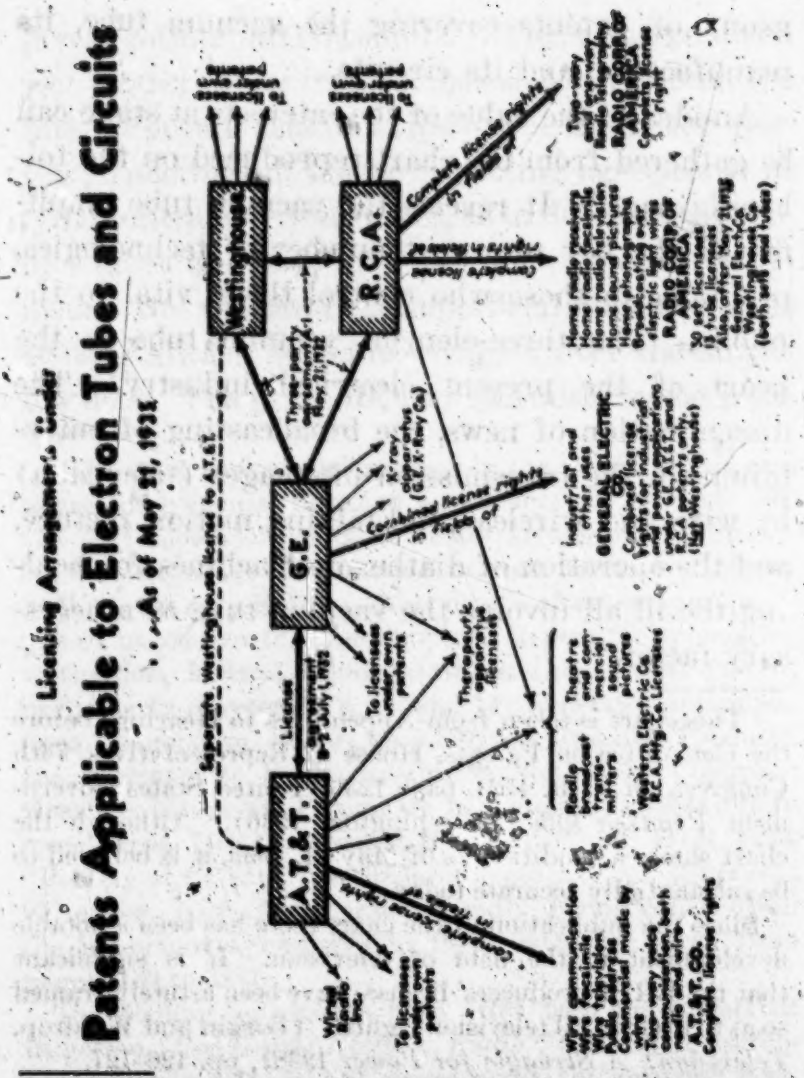
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[2] This chart is taken from Appendixes to Hearings before the Committee on Patents, House of Representatives, 74th Congress, on H. R. 4523, page 1236 (United States Government Printing Office, Washington, 1936). Although the chart shows a condition as of May 21, 1935, it is believed to be substantially accurate today.

Since the publication of the chart there has been a notable development in the field of television. It is significant that the ERPI producers' licenses have been astutely framed so as to exclude all television rights. (Borkin and Waldrop, *Television: A Struggle for Power* 1938), pp. 126–127.

[3] The importance of the vacuum tube is illustrated by the following statement of George E. Folk, former General Patent Attorney for the respondent Telephone Company (*Lindheimer* v. *Illinois Tel Co.*, 292 U. S. 151 [Transcript of Record, Vol. II, p. 1220]):

"There is no clear line of demarcation between radio and certain modern wire development. The three-element vacuum tube has frequently been referred to as the heart



of radio. It can with equal truth be referred to as the heart of the carrier current, wired telephony and telegraphy. As in radio, this tube is used for amplifying currents, generating frequencies, for modulating frequencies, for splitting up frequencies, for detection or demodulation.

"The same is true with reference to carrier currents, wire telephony and telegraphy. Practically the same type of

The United States submits that the implications that may be drawn from this Court's first opinion in this case may have a serious effect upon the growth of arts and technologies of the greatest social and economic importance. The result may be to encourage private restrictions both in industries dependent upon the vacuum tube and in a myriad of other industries dependent upon other patented devices. Such restrictions must necessarily impede and discourage healthy competition and private enterprise.

If the considerations of public policy which have impelled the United States to file this brief are to be thoroughly understood, the legal issues of this case should be considered against the background of the historic development of the technology in the industry and of the struggles which have taken place to obtain control of that technology.

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apparatus is used. Certainly, so far as the patents are concerned, there is no distinction, whether it is a wired or a wireless device."

Frank B. Jewett, Vice-President of the same company and President of its research subsidiary, the Bell Telephone Laboratories, has said (Borkin and Waldrop, *Television: A Struggle for Power* (1938), at pages 27–28):

"The invention of the vacuum tube as a satisfactory amplifying modulating tube . . . opened up the door through which have come not only all of the things which have created this [modern electrical] industry, but likewise all of the things which have created the problems which are confronting this [governmental regulatory] commission and the industry at this present time. [Brackets supplied.]"

A. THE EARLY DEVELOPMENT OF THE VACUUM TUBE AND THE ORGANIZATION OF THE AMPLIFIER INDUSTRY

At the opening of this century, radio broadcasting and reception were in a highly experimental stage. There was no effective means available for the amplification of extremely weak currents; as a result, very little could be done along lines of commercial value. The demand for an amplifier led to the development of the vacuum tube; the first patents covering the three-element tube were issued to Lee DeForest in 1907 and 1908.[4]

While the tube was first developed for radio purposes, its utility in wired communication soon became apparent. But even before this the Bell Telephone System, of which the Telephone Company is the head, became interested and took steps to obtain control of the new device.[5] For years the Bell System had maintained an aggressive policy of acquiring patents in the communications field, and in related areas. The object was to protect and extend the monopoly which it had originally achieved through the old Bell patents. These had expired, but by various methods, including the acquisition of patents on equipment and accessories, the company had retained its dominant position.[6]

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[4] Compare *DeForest Radio Co.* v. *Gen. Elec. Co.*, 283 U. S. 664 (1931); Proposed Report, Telephone Investigation, Federal Communications Commission (1938), pp. 210–212.

[5] *Id.*, p. 213.

[6] *Id.*, pp. 149–150.

The vacuum tube amplifier offered possibilities of improvement in long distance service which would give undisputed ascendancy in that branch of the telephone art. The Telephone Company, accordingly, proceeded to obtain control of the patents on the vacuum tube and by 1914 this had been accomplished. The only exception was that DeForest, the inventor, retained a non-transferable, personal right to the use of the tube.[7]

The outbreak of the World War found radio transmission and reception still in an undeveloped stage. Greater efficiency became essential and the government stepped in to bring about cooperation between the various concerns interested in wireless.

This intervention resulted in a certain amount of cooperation in the use of the patents so far as production for the government was concerned.[8]

The War ended and with it the period of cooperation through governmental pressure. The field was again free for unlimited rivalry between the large concerns controlling radio, the Telephone Company and the General Electric Company. The latter had developed important interests in this field. Alexanderson, of the General Electric Research Laboratory, had succeeded in building a high frequency alternator which corrected some of the existing defects in wireless broadcasting.[9]

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[7] Proposed Report, Telephone Investigation, Federal Communications Commission (1938), page 255.

[8] Encyclopedia of the Social Sciences, "Radio."

[9] *Op. cit.*

This development promised to be of great c
mercial value and the British-Marconi syst
opened negotiations for the purchase of the A
anderson patents. These negotiations, howe
were never consummated and in 1919 RCA was
ganized through the instrumentality of the Gen
Electric Company for the purpose of taking o
the patents. The new corporation bought out
American-Marconi system and made a patent p
and exclusive dealing agreement with General E
tric.[10]

The next step in the organization of the field t
place in 1920 when the major companies interes
in the industry entered the first of the radio
amplifier cross-licensing agreements. The c
panies included General Electric, RCA, the T
phone Company, and Western. Soon afterwa
RCA made a similar agreement with United Fr
Company and acquired the radio interests of
Westinghouse Electric and Manufacturing C
pany.[11] The object and effect of these agreeme
were to divide the wireless and communicati
fields among the contracting parties. The arra
ment was not frictionless, however, and during
years immediately following serious disagreeme
arose.

B. THE DEVELOPMENT OF SOUND PICTURES AND
CONTEST FOR CONTROL

In 1925 the talking picture was technologic
in the experimental stage; commercially it wa

[10] Compare Encyclopedia of the Social Sciences, "Ra
[11] *Id. loc. cit.*

small importance. In the course of the succeeding thirteen years the technology of the sound picture has been perfected and the devices of this technology have acquired great commercial value. From the beginning this new industry has been dominated by RCA and the Telephone Company because they controlled the amplifying devices which were essential factors in the technological development.

The commercial development of the sound film has been marked by a series of conflicts among the interested parties. For present purposes two of these conflicts are of particular significance. In the first place the Telephone Company and RCA fell out over the division of this new and profitable field. Later these two companies were forced to defend their hegemony against the independent suppliers of sound equipment.

It is unnecessary to describe in detail in this brief the various events which preceded and accompanied the first attempts to introduce sound into the motion picture industry and to produce sound pictures on a large scale.[11] It is enough to say that

[11] Interesting material with respect to this subject may be found in the opinion of the district court in *General Talking Pictures Corp.* v. *American Tel. & Tel. Co. et al.*, 18 F. Supp. 650; in the Hearings on H. R. 4523, page 423, Committee on Patents, House of Representatives, 74th Congress; and in the Proposed Report of the Federal Communications Commission prepared pursuant to Public Resolution No. 8, 74th Congress.

as a result of these developments the Telephon
Company in January 1927 organized ERPI, a
that in May 1928 ERPI granted licenses to all b
one of the major companies engaged in the pr
duction of motion pictures which permitted tho
companies to produce sound pictures with equi
ment manufactured by Western and covered
patents owned by the Telephone Company or o
of its subsidiaries.[13] By means of a contractu
lease executed simultaneously with these recordi
licenses, the producers agreed to install Weste
reproducing equipment in all theatres under the
control or in which they had an interest.[14]

Meanwhile a struggle for supremacy in the equi
ment-producing field had been taking place. A se
tlement in 1926 was concerned primarily with all
cation of rights in the radio and communicatio
field. With some limitations the Telephone Co

[13] Proposed Report, Telephone Investigation, Feder
Communications Commission (1938), p. 473.

[14] The contracts made by the Telephone Compan
through its subsidiaries, with the producing companies co
tained a number of other provisions obviously intended
extend and preserve the Telephone Company's domina
position. For example, the contracts provided (1) for t
payment of royalties to ERPI on the distribution of co
petitive equipment by producer-licensees of ERPI, (2) t
payment of royalties to ERPI on sound film produced
its licensees on competitive equipment where technical a
vice or Telephone Company patents were used, and (
the payment of substantial minimum annual royalties.

pany obtained exclusive licenses as to wire telephony; the RCA group as to radio telegraphy. Nonexclusive licenses were exchanged as to sound recording and reproduction for commercial motion picture purposes. Other fields of sound recording were partitioned between the communication companies by means of exclusive licenses.[15]

As the commercial importance of talking pictures increased, further controversies arose between the Telephone Company, represented by ERPI, and RCA. The first cause of serious dissention arose from the fact that the restrictions of the ERPI licenses operated in practice to prevent the use of competitive equipment by motion picture producers or distributors. In 1928 RCA, and a committee representing producers holding ERPI licenses, demanded modification of these provisions, and this was secured after negotiations and after suit had been threatened by RCA.[16]

Another cause of friction between RCA and the Telephone Company arose by reason of the royalty provisions incorporated in ERPI producer recording licenses. By those provisions the producer was required to pay royalties to ERPI upon all sound records produced or distributed by it which were made (1) with the use of any technical information

[15] Compare, Proposed Report, Telephone Investigation, Federal Communications Commission (1938), pp. 260–262.

[16] *Id.*, pp. 475–476.

supplied by ERPI or (2) with any equipment, method, or system covered by any of the patents or embodying any of the inventions under which licenses were granted by ERPI to its licensee. Therefore, the use of competitive recording apparatus was unrestricted only where the sound record was produced by the licensee without the use of technical information supplied by ERPI and where no one of the many component parts of the recording equipment infringed upon or was covered by patents in respect of which ERPI was permitted to issue licenses. In effect, then, a producer had to pay a royalty to ERPI if it distributed a picture recorded with RCA equipment even though a royalty for the production of such recording had been paid to RCA by the original producer. This question was disposed of between the communications companies in the cross-licensing agreements of 1932, after RCA had threatened suit.

Furthermore, if the licensee produced sound records by the use of any technical information supplied by ERPI or with any equipment, method, or system covered by any of the patents or embodying any of the inventions in respect of which licenses were granted by ERPI, then the licensee was required to pay ERPI a royalty equal to the amount payable if the ERPI sound system had been used. The requirement of the payment of a royalty to ERPI in addition to the one paid to RCA by the

recording producer made it impractical for ERPI licensees to record with competitive equipment. Another threat of a law suit by RCA brought a settlement of this controversy in 1935, but only after protracted negotiations. In both cases ERPI gave up its claims to the royalties so far as RCA was concerned. The independent equipment manufacturers were not given the benefit of these concessions.[17]

The settlement of these questions terminated hostilities as between the communications companies and left them free to take steps to limit competition by independents.

C. THE STRUGGLE WITH THE INDEPENDENTS

As the sound apparatus industry was emerging from its promotional stage, independent producers of equipment not connected with the communications interests began to appear. For example, the defendant, General Talking Pictures, was organized in 1928 to take over the assets of the commercially unsuccessful DeForest Phonofilm Company and to place on the market a line of sound reproducing apparatus to compete with that of the communications companies and their licensees.[18]

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[17] See Federal Communications Commission, Report on Electrical Research Products, Inc., pursuant to Public Resolution No. 8, 74th Congress (1937), p. XXI.

[18] R. 367.

The restrictive provisions in the ERPI lice
above discussed, and other restrictive provis
relating to repairs, replacement parts, and ser
ing,[19] operated to exclude the independent ma
facturers from the field. As a result, the T
phone Company and its subsidiaries maintain
highly favorable position in the manufactur
reproduction equipment.

"These tactics did not go unchallenged. Ger
Talking Pictures, Inc. commenced an action in
United States District Court for the Distric
Delaware under Sections 3 and 16 of the Cla
Act. The district court in Delaware held that
practices of the companies in the Telephone C
pany group were illegal, but this opinion
handed down after the restrictive provisions in
license agreements had become obnoxious to I
and had been eliminated (*General Talking
tures Corp.* v. *American Tel & Tel. Co. et al*
F. Supp. 650).

In May 1930 the United States brought sui
the United States District Court for the Distri
Delaware against both RCA and the Telep
Company alleging that the defendants were gu
of an unlawful combination and conspiracy in
straint of the manufacture, use, and sale of r
apparatus and that their activities violated

[19] Proposed Report, Telephone Investigation, Fe
Communications Commission (1938), p. 478.

Sherman Act. Negotiations between the government and the defendants led to a new cross-licensing agreement of July 1, 1932. This agreement was submitted to the court, and a stipulation was filed which resulted in a consent decree.[20] This decree provided for divestiture of stock holdings affecting the control of the RCA and also for the elimination of the exclusive provisions of the 1926 license agreement. The decree and the cross-licensing agreement did not purport to authorize a restrictive provision in amplifier licenses. There is, however, some evidence that the communications interests were aiming at restriction. Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, appraised the new agreement as follows:[21]

> The proposed agreement is not a free interchange of nonexclusive licenses between the contracting parties. It is an interchange of nonexclusive licenses with limitations of use. In many cases the grants are unilateral, and in others * * * the limitation of field is such as to make the apparent grants to use actually of little or no value. *Broadly speaking, the practical effect of the agreement is to limit the field of possible development of each party to its present major activities.* [Italics supplied.]

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[20] *United States* v. *Radio Corporation of America et al.*, D. C. Del., Eq. 793 (1930).

[21] Letter of June 30, 1932, Federal Communications Commission, Proposed Report, Telephone Investigation (1938), p. 264.

The respondents quote the following paragraph from the contract made in connection with the consent decree:[22]

> 4. Each party agrees that, so far as it is enabled so to do, it will in disposing of devices embodying inventions pertaining or applicable to vacuum tubes, or to generating, modifying, amplifying, transmitting or receiving electro-magnetic waves, or other devices or material the unrestricted sale of which would deprive the other party of rights to which it is entitled hereunder, use such precautions by contracts, restricted licenses or otherwise as may be necessary or advisable in order to prevent its customers or others from acquiring (by acquisition of devices from it or otherwise) licenses to use the same which the party disposing thereof has no right to grant.

They add that this agreement was approved by the government. It may be assumed that the respondents do not mean to imply that the government approved the particular license provisions which are in issue in the instant case. The apparent purpose of the clause was to give such protection as the law allows against the indiscriminate distribution of licenses. The contract does not purport to enlarge the scope of the monopoly granted by the patent law, and it is immaterial for the purposes of this case.

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[22] Respondents' brief, p. 59.

III

The Restrictive Provisions of the License Are an Attempt to Extend the Patent Monopoly Beyond the Statutory Grant

The respondents are attempting to enforce the provision of the license to the American Transformer Company which permits the company "to manufacture * * *, and to sell only for radio amateur reception, radio experimental reception, and radio broadcast reception." The effect of this provision is to bar the licensee from manufacturing and selling the patented device for use in the motion picture field. If the respondents as the owners of the patents had manufactured the patented article and sold it to the petitioner with a similar restriction as to its use, the attempted restriction would have been invalid. The respondents cannot, by including a restrictive provision in a license agreement, accomplish by indirection a result which they would be powerless to achieve if they had themselves manufactured and sold the patented article. Stated otherwise, it is the contention of the United States that the power of the owner of a patent to control the ultimate use and disposition of the patented article is no greater when he frames the provisions of a license agreement than it is when he sells the article.

Prior to its decision herein, this Court has never

held that the owner of a patent may grant a license which by its terms restricts the right to manufacture and sell the patented article for use in a particular industrial field.[23] Nor has this Court ever held that the owner of a patent may himself manufacture and sell a patented article with the restriction that it be used only in a particular field.

On the other hand, in a long line of decisions this Court has struck down attempts to extend the patent monopoly beyond the statutory permission to make, use, and vend. Thus, this Court has held that the owner of a patent may not use the patent privilege to fix and maintain the price of the patented article after it has passed into the possession of dealers and the public. *Straus* v. *Victor Talking*

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[23] The decision in *Rubber Company* v. *Goodyear*, 9 Wall. 788, cited by this Court in its first opinion as authority on this point is not conclusive. There the restriction in the license was to use by the licensee at "his own establishment." This appears to be little more than a restriction, which would be implied in any event, that the use was to be by the licensee himself and not by others. At the most, this case stands for nothing more than the proposition that certain restrictions as to the *place* of use are permissible. The decisions in *Gamewell Fire-Alarm Telegraph Co.* v. *Brooklyn*, 14 Fed. 255; *Dorsey Rake Co.* v. *Bradley Co.*, Fed. Case No. 4,015, 7 Fed. Cas. 946, 947, are equally inconclusive. The first of these cases decided nothing more than that in an action by licensee for infringement a demurrer on the ground that the owner to the legal title to the patent had not been made a party was well founded. In the second of these cases the restriction appears to have been a restriction as to place of use rather than a restriction as to use in any particular field of industry.

Mach. Co., 243 U. S. 490; *Boston Store* v. *American Graphophone Co.*, 246 U. S. 8. *Cf. Bauer* v. *O'Donnell*, 229 U. S. 1.

This Court has also held that the patent privilege cannot be used to obtain a monopoly control over unpatented materials which are used in connection with the patented article. *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502; *Carbice Corp.* v. *Am. Patents Corp.*, 283 U. S. 27; *Leitch Mfg. Co.* v. *Barber Co.*, 302 U. S. 458. *Cf. International Machines Corp.* v. *United States*, 298 U. S. 131.

The cases cited afford compelling analogies for decision of the case at bar. If anything, the restriction here considered is the more direct, and therefore the more obvious. It operates directly upon the conduct of the purchaser and controls his use. If an indirect restraint upon him, such as a resale price restriction, is without the patent grant, *a fortiori* the restrictions attempted here must also be beyond it.

Adams v. *Burke*, 17 Wall. 453; *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659; and *Mitchell* v. *Hawley*, 16 Wall. 544, do not support a contrary view.[24] These cases did not involve restrictions on the use of patented articles.

In *Adams* v. *Burke*, 17 Wall. 453, a license to

[24] Cases dealing with the obligations assumed by the *parties* to license contracts are not in point. *Cf. Bement* v. *National Harrow Co.*, 186 U. S. 70; and *United States* v. *Gen. Elec. Co.*, 272 U. S. 476, 489.

manufacture and sell had been granted, limited to an area within a radius of ten miles from Boston. The licensor sued the defendant on the ground that he had infringed by using the patented article outside the limited area. The defendant pleaded in bar that he had not used any of the patented articles except such as *had been manufactured and sold by the licensee within the limited area.* This Court upheld the plea on the ground that the *restriction as to manufacture and sale* had not been violated. This was the only issue in the case, and the decision, therefore, cannot be regarded as establishing in any way the validity of the restrictive provision itself.[25]

The facts in *Keeler* v. *Standard Folding Bed Co.*, 157 U. S. 659, were substantially similar to those in *Adams* v. *Burke,* 17 Wall. 453, and this Court properly regarded the latter decision as controlling.

In *Mitchell* v. *Hawley,* 16 Wall. 544, relied upon by respondents, the patentee granted a license to

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[25] As this Court said in *Dewey* v. *Des Moines*, 173 U. S. 193, 200:

"A claim or right which has never been made or asserted cannot be said to have been denied by a judgment which does not refer to it. *Hamilton Company* v. *Massachusetts*, *supra.* A point that was never raised cannot be said to have been decided adversely to a party, who never set it up or in any way alluded to it. Nor can it be said that the necessary effect in law of a judgment, which is silent upon the question, is the denial of a claim or right which might have been involved therein, but which in fact was never in any way set up or spoken of."

run for the balance of the original term of the patent. This Court held that the license by its terms conferred no right after the date of the expiration of the original patent even though the term of the patent had subsequently been extended by the Commissioner of Patents. No question as to the validity of the restriction was involved or decided.

Furthermore, these cases may be distinguished on other grounds. It will be noted that they were decided at an early date, before the law with respect to monopolies and restraints on trade was as fully developed as it is today. They do not purport to establish broadly that restrictions even of time and place of use must be generally upheld, and in view of other earlier precedents this is doubtful, to say the least.[26] Clearly they fall far short of establishing the proposition that the owner of a patent can grant a license to manufacture and sell, which by its terms prohibits the licensee from selling the patented article for use in certain specified economic fields. Certainly nothing in these cases suggests that the owner of a patent can himself sell articles covered by the patent on condition that the articles be used only for specified purposes and enforce that condition against any one into whose hands the articles come.

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[26] *Cf. Wilson* v. *Rousseau et al.*, 4 How. 646; *Simpson et al.* v. *Wilson*, 4 How. 709; *Bloomer* v. *McQuewan et al.*, 14 How. 539; *Hobbie* v. *Jennison*, 149 U. S. 355.

If the kind of running restriction here involved cannot be imposed by the patentee if he chooses to sell the patented article, it cannot properly be included in a license agreement. The patentee cannot extend the scope of his privilege by choosing to license rather than to sell. To attempt to evaluate the legal content of permissible legal restrictions on the basis of whether a sale is attempted or title to the patented article passes is to ignore the realities of the situation. The controlling principle is that the patent privilege does not go beyond the right to make, use, and vend and that the limitation of that privilege cannot be avoided either by license or by the terms of sale, so as to permit the patentee to control the use of the patented article for the purpose of establishing monopoly control over an entire field of economic activity.

IV

The Fact That the Petitioner Had Notice of the Restrictive Provisions of the Vendor's License Has no Bearing on the Question of the Legality of Those Provisions

Respondents rely heavily upon notice or knowledge by the petitioner of the restrictive provisions contained in the licenses granted to the American Transformer Company. Whatever relevance that circumstance might have on subordinate issues in the case, it cannot affect and control the question

of the legality of the restrictive provisions. Notice cannot make an illegal restriction legal or else all limitations upon the patent monopoly are illusory.

The argument of the respondents throughout is circular; it assumes what it is called upon to prove. It may be stated shortly in two parts: (1) Since the owner of a patent is free to license or not to license as he pleases, he is free to license for one use and not for another; (2) if this is not so, nevertheless, knowledge of his attempt to enforce an illegal restriction turns the tables and extends the patent grant. The public policy opposed to such results has been argued earlier; as a mere matter of logical statement the arguments cannot prevail.

The first may be restated thus: since a license is "no more than an agreement not to prosecute for infringement," he is legally free to agree not to prosecute if the article embodying the patent is put to a specified use and equally free at law to prosecute if it be put to an unauthorized use. Such a proposition—from which the respondent's whole argument flows—begs the question. In brief, it recites that the whole must comprehend the part, without specifying what the whole is. It makes an absolute of a property right and erases the limitations on a privilege given for a purpose. Yet, by well established and clearly defined law, the rights of the owner of a patent are limited to the privileges which it conveys. He cannot impose

upon a licensee restrictions which do not inhere in the grant he possesses. His freedom to "do as he will with his own" stops sharply at the barriers upon restrictive use described by public policy. Outside his limited monopoly, the covenants, the licenses, the arrangements by which an invention is turned to account are subject to the general law of the land. The freedom to grant or to withhold does not define the identity of the thing given.

The effect of the contention, therefore, is to raise a question rather than to take a stand upon a rule of law. The real issue—the issue in the instant case—is what the limits of the privilege are which by license the owner of a patent farms out to another. Is the right to license for one use but not for another an aspect of the privilege inherent in the grant of patent? Or is it a restraint upon trade that renders the Sherman Act inoperative and is therefore illegal? This is the issue which is now before the Court.

To this issue the law has given a clear-cut answer. The argument, that since a patentee may decline to sell or license he may, therefore, sell under restrictions, simply does not march. The whole law of personal property is to the contrary. As a general rule one cannot clothe another with the seeming indicia of ownership and still reserve property rights against third persons.

Again, in order to spell out a patent infringement so as to avoid having only an unjustified claim of fraud under the general laws, it has to be asserted that the original sale by the Transformer Company was invalid, as in violation of the license, in view of the intent of the parties not to observe the license. This means that mere intent and not act is an infringement of the patent laws. It means that even if the petitioner observed the license requirements, yet the sale was void from its inception and it is nevertheless subject to an accounting. Clearly there is not going to be an actionable infringement unless the purchasers use the patented article in violation of the restriction. The restriction is valid only if it can be said that the patentee merely "vended" so much of his right as was not covered by the restriction, which comes merely to saying that the restriction is valid under the law of patents. Once it is held not covered by the law of patents, the notice or knowledge adds nothing more unless the general law assists to that end.

If, as the United States contends, the restrictive provision in the license agreement was invalid because it was an attempt to extend the patent privilege beyond its permissible limits, that illegality was not modified or abolished by petitioner's notice and knowledge. It is of no moment that the

petitioner may be said to have acted in deliberate disregard of the asserted rights of the respondents. If the provision in the license was illegal, the petitioner was entitled to disregard it.[27]

This Court has never permitted notices of patents or notices of licenses to be used for the purpose of extending the patent privilege beyond its legal bounds. For example, in *Straus* v. *Victor Talking Mach. Co.*, 243 U. S. 490, 500–501, this Court dismissed as of no legal consequence a so-called "license notice" which had for its obvious purpose the maintenance of resale prices on the patented article. In that case the Court said:

> Courts would be perversely blind if they failed to look through such an attempt as this "License Notice" thus plainly is to sell property for a full price, and yet to place restraints upon its further alienation, such as have been hateful to the law from Lord Coke's day to ours, because obnoxious to the public interest.

Compare *Motion Picture Co.* v. *Universal Film Co.*, 243 U. S. 502, 509.

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[27] Stress is placed upon some additional scope to be accorded to petitioner's *knowledge*, as distinguished from a patent *notice*. There is no basis in either policy or law for a distinction here. It is only fair to point out, however, that petitioner's knowledge was really acquired only in pursuit of its seeking—and obtaining—the advice of counsel that the restriction was invalid in law. No equities should be drawn from this circumstance.

The logic of denying legal effect to notice and knowledge requires no elaboration. Indeed, it would be pointless to hold that a restriction such as here involved is illegal but that its illegality is cured if a purchaser of the patented article has notice and knowledge of the provision in existence. Under such conditions the prohibition of the law against such restrictions would be of no practical avail. It would be easy for the owner of patents by notices, and by other steps calculated to fix prospective purchasers with knowledge, to require the use of unpatented materials with patented devices to fix and maintain resale prices and to accomplish other purposes which this Court has held to be illegal. Compare, for example, the remark of Dean Carl Barus, of Brown University, quoted in Vaughan, *Economics of Our Patent System*, page 102:

> If one looks, for instance, at the highly ingenious contrivances by which the marvels of the Hertzian wave have recently been brought to the appreciation of the people, one is struck by the appearance on every clamp, every ferrule, every coil, every tube, almost on every plate and screw, of the mysterious symbol, PAT. This PAT is a cipher more potent than any formula of Cagliostro. It is behind an array of PAT, that the wisdom of the future will be entrenched, and above which so much of it as may be vouchsafed us will be broadcast.

V

The Running Restriction Involved in This Case Is Violative of Well-Established Public Policy; It Is Inconsistent With the Policy of the Antitrust Laws; It Does Not Promote the Purpose of the Patent Law and May in Fact Defeat That Purpose

A patent grant is an exception to the general legislative policy against monopolies and restraints of trade. The determination of how far that exception extends, and for what purpose it may be used, is one which must necessarily be made in the light of considerations of legislative policy and public benefit. In some patent cases the issue is presented in a clash between competing objectives which is difficult of resolution. The stimulation of invention must be set off against prohibition of monopolistic practices. In such instances public policy turns upon a neat balance of considerations which the courts must weigh as well as they can. The instant case seems free from such a conflict of policy. The respondents demand not protection for the invention but an extension and amplification of the rights hitherto granted under the patent law. It is doubtful whether the incentive inherent in such an extension—if the extension holds an incentive—can stimulate the progress of the art by increasing the prospective reward to the inventor. Not only must it cut across all barriers of distance, the sale of patents to large corporate organizations,

and the salaried position of the inventor, but it must reach an inventor so delicately attuned to pecuniary stimulus that he will invent with an eye upon restrictive licenses but refuse to invent if licenses, as well as sales, must be unrestricted as to use.

It is evident on the other hand that the extension will foster monopolistic control. The Court has rejected, as inconsistent with public policy as embodied in the statute, a number of ingenious devices designed to use a patent grant as a sanction for exclusive and restrictive arrangements in the distribution and use of patented articles. It has rejected restrictions upon place of use, time of use, maintenance of resale price, and use with complementary goods supplied by the owner of the patent. It has declared invalid covenants by which the patent owner, who manufactures for himself, has sought to control the product which he has sold. A decision for the respondents will put in jeopardy this whole line of judicial decision. In modern industry technology and marketing arrangements are closely interwoven. The situation presents an insistent and continuous opportunity for the display of ingenuity. If one practice is forbidden, another is quickly contrived to effect its end. The history of antitrust litigation is replete with examples of usages of trade which have served their turn, been found to be without the law and have given place to others.

The running restriction here in question, if declared valid, may be made a new instrument to attain forbidden objectives. The owner of the patent, instead of manufacturing, will be encouraged to license other corporations, frequently its own subsidiaries, to fabricate the patented article. It requires little imagination to see how the running restriction here in question can then be used to effect a control over place of use, time of use, complementary goods, and even resale price. Had a procedure been made to order to accomplish these legally forbidden ends, it is hard to see how the trade practice here in question could be improved upon.

Counsel suggest that the purpose and effect of the restriction is to limit the patent license to production for non-commercial purposes. This does not seem an adequate explanation, since radio and broadcast reception have possibilities of important commercial use as well as of pleasure and entertainment for the home. Instead, the restriction seems clearly one to secure the division of potential sales among various licensees of the patent owners, separating, for example, the radio business from that of the talking moving pictures or of telegraphic and telephonic communication. The extreme scope of this particular restriction is indicated by the fact that an officer of one of the respondents, in response to an inquiry from the licensee, the Transformer Company, stated that a purchaser from the licensee of a power supply am-

plifying unit might use it for a radio receiving set, but could not use it for an electric phonograph (R. 3642). And yet this is a type of combined usage which has now become most popular, easily capable of arrangement by the householder in the home without the aid of skilled mechanics. If a restriction of this kind is valid it means that a patent owner may regulate and limit the use of the patented article substantially as he pleases in the homes and businesses of the ultimate consumer and without regard to the inconvenience or hardship to the latter. And each non-authorized use makes the person an infringer of the patent and subject to all the remedies in tort and contract, in law and equity, for his illegal act.

The patented device in suit is now practically a necessity of modern life. If running restrictions like the present one are sustained, the public will be subjected to large inconvenience and to the uncertainties and expense of litigation. The possibilities of monopoly thus afforded may not be so immediately perceived, but are perhaps even more important; for they arise from a legal device whereby patent assignees can dominate the market for their product wherever it may be and however far removed. That this is not an idle fear, that the device is capable of use with far-reaching possibilities, is illustrated by the very patent pool operated by the respondents in this case, a pool of gigantic proportions, several times already the object of judicial or administrative inquiry.

If the respondents are successful in this litigation, they will attain a position of economic power far in excess of any contemplated by the men who drafted the language of the constitutional provision or by the legislators who enacted the patent laws. In the simpler economy in which the notion of the patent was born, the usual patent monopoly was nothing more than the exclusive right to produce for a limited period of years. The public was not at the mercy of the patent holder. In the first place the organization of society and industry was simpler. Patents, for the most part, cover relatively simple devices or processes in their entirety; industry was not dependent upon intricate devices consisting of numerous parts separately patented, the control of any one of which was sufficient to obstruct the development of the art. In the second place competitive conditions in industry restrained the owner of the patent from attempting to obtain exorbitant profits.[28]

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[28] Compare the following statement made by the Committee of the House of Representatives on Patents in House Report No. 1161, 62nd Congress, Second Session, pages 2 and 3:

"The patent law was enacted before any of our trusts came into existence; when competition was the accepted law of trade, and when combinations in restraint of trade were not in contemplation. So long as such conditions continued and the avenues of competition were kept open the monopoly granted by the patent law, limited as it was, in time tended to stimulate competition. It incited inventors to new effort and capitalists and business men were encouraged to develop inventions. Under these conditions a patent, while granting a monopoly in a specific article, had rarely a tendency to monopolize any branch of the trade,

The respondents, on the other hand, stand in a different position from that of the inventor and the entrepreneur of the mercantile period. They have obtained control of a device which is a key to processesses the public cannot do without. If they are successful in this litigation, and in the restrictive policies which they have adopted, the charges and tariffs which they impose will be restrained only by their own conceptions of the public interest. Finally, they are attempting to obtain a power which will enable them to close the field completely in any particular line of development without affecting gains which they may be deriving from others. The use of the patent privilege to establish and maintain economic power of this scope cannot be justified by the constitutional provision, by the patent laws, by the decisions of this Court, or by any considerations of public policy.

It may be contended that restrictive provisions, such as those in issue here, are a necessary incident of the patent privilege, and that otherwise there will be no incentive to invention with the result that technological development will be impeded and trade and commerce discouraged. It seems obvious that the running restriction in question can stand no such reference and serve no such objectives. The patents in question are not owned by

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because few inventions were so fundamental in character as to give the owner of the patent a monopoly in any branch of the trade, and every great financial success arising from an individual patent was sure to result in rival inventions."

the inventors. Rights to the techniques in que
tion now rest in hands three or even four time
removed from the original inventors. The curre
progress of the art is an affair of the laborator
the practical work is done by men who are engage
on salary and who in advance assign their righ
to the corporations for which they work. It woul
require an argument evolved out of tenuous step
to connect the amount of their emoluments with th
running restrictions here in question. To go be
yond that and to make those restrictions causal t
the progress of science and the useful arts is t
indulge in speculation drawn to gossamer finenes
A rule of law must be grounded in probabilities;
should not rest upon the sands of such remot
possibilities.

Far from stimulating the genius of the inve
tor, a grant of the privilege here sought ma
have stifling consequences for invention. Th
law of patents presumes an exclusive right i
an invention; the respondents, blessed with a fa
vorable verdict, will be enabled to monopoliz
an entire art. The liberties sought here, as
buttress to their own patent pool, would pu
them in command of an electrical technolog
which penetrates the whole industrial system an
has woven itself into our modern culture. Thi
technology has been many decades in the mak
ing; a host of individuals have contributed t

its advanced state. The dominant discoveries have been the work of scientists, who have been intent upon exploring the world of the unknown. It is upon the foundations of their work, unrewarded by royalties and spurred by other incentives than exclusive rights, that the inventors have worked out the devices which have been patented. By the grant of patents, a pooling of patents, and covenants between interested parties, a series of exclusive rights have been thrown across the whole stream of the developing technique. If the running restriction here at issue is allowed, the grants sanctioned by patent will pass far beyond the particular invention and will virtually comprehend a monopoly of the whole art. It will be all but impossible for the individual inventor outside the corporation—without imminent danger of infringing a patent—to get such a foothold in the accumulated technology (which should be common property) as to allow him to develop new ideas and to give play to them in novel devices. It is far from the contemplation of the statute that the right to a patent should become a monopoly of a developing art. Otherwise, a law intended to give effect to the constitutional mandate to promote the progress of science becomes an instrument for its discouragement.

CONCLUSION

For the foregoing reasons, it is respectfully
mitted that the two questions now before the
should be answered in the negative.

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U. S. GOVERNMENT PRINTING

P. 1

SUPREME COURT OF THE UNITED STATES.

No. 1.—October Term, 1938.

General Talking Pictures Corp., *vs.* Western Electric Co., Inc., Electric Research Products, et al. } Certiorari to the Circuit Court of Appeals for the Second Circuit.

[November 21, 1938.]

Mr. Justice Brandeis delivered the opinion of the Court.

In this case, we affirmed on May 2, 1938 (304 U. S. 175), the judgment of the Circuit Court of Appeals (91 F. (2d 922), which held that respondents had infringed certain patents relating to vacuum tube amplifiers. On May 31st, we granted a rehearing (304 U. S. —), upon the following questions which had been presented by the petition for certiorari.

1. Can the owner of a patent, by means thereof, restrict the use made of a device manufactured under the patent, after the device has passed into the hands of a purchaser in the ordinary channels of trade, and full consideration paid therefor?

2. Can a patent owner, merely by a "license notice" attached to a device made under the patent, and sold in the ordinary channels of trade, place an enforceable restriction on the purchaser thereof as to the use to which the purchaser may put the device?

Upon further hearing we are of opinion that neither question should be answered. For we find that, while the devices embody the inventions of the patents in suit, they were not manufactured or sold "under the patent[s]" and did not "pass into the hands of a purchaser in the ordinary channels of trade."

These are the relevant facts. Amplifiers embodying the invention here involved are useful in several distinct fields. Among these is (a) the commercial field of sound recording and reproducing, which embraces talking picture equipment for theatres, and (b) the private or home field, which embraces radio broadcast reception, radio amateur reception and radio experimental reception. For the commercial field exclusive licenses had been granted by the pat-

ent pool to Western Electric Company and Electrical Research Products, Inc. For the private or home field the patent pool granted non-exclusive licenses to about fifty manufacturers. Among these was American Transformer Company. It was licensed

"solely and only to the extent and for the uses hereinafter specified and defined . . . to manufacture . . . , and to sell . . . only for radio amateur reception, radio experimental reception and radio broadcast reception . . . licensed apparatus so manufactured by the Licensee. . . ."

The license provided further:

"Nothing herein contained shall be regarded as conferring upon the Licensee either expressly or by estoppel, implication or otherwise, a license to manufacture or sell, any apparatus except such as may be manufactured by the Licensee in accordance with the express provision of this Agreement."

Transformer Company, knowing that it had not been licensed to manufacture or to sell amplifiers for use in theatres as part of talking picture equipment, made for that commercial use the amplifiers in controversy and sold them to Pictures Corporation for that commercial use. Pictures Corporation ordered the amplifiers and purchased them knowing that Transformer Company had not been licensed to make or sell them for such use in theatres. Any use beyond the valid terms of a license is, of course, an infringement of a patent. Robinson on Patents, § 916. If where a patented invention is applicable to different uses, the owner of the patent may legally restrict a licensee to a particular field and exclude him from others, Transformer Company was guilty of an infringement when it made the amplifiers for, and sold them to, Pictures Corporation. And as Pictures Corporation ordered, purchased and leased them knowing the facts, it also was an infringer.

The question of law requiring decision is whether the restriction in the license is to be given effect. That a restrictive license is legal seems clear. *Mitchell* v. *Hawley*, 16 Wall. 544. As was said in *United States* v. *General Electric Co.*, 272 U. S. 476, 489, the patentee may grant a license "upon any condition the performance of which is reasonably within the reward which the patentee by grant of the patent is entitled to secure." The restriction here imposed is of that character. The practice of granting licenses for a restricted use is an old one, see *Rubber Company* v. *Goodyear*, 9 Wall.

800; *Gamewall Fire-Alarm Telegraph Co.* v. *Brooklyn*,
55. So far as appears, its legality has never been ques-
he parties stipulated that

mon practice where a patented invention is applicable to
uses, to grant written licenses to manufacture under
ates Letters Patents restricted to one or more of the
lds of use permitting the exclusive or non-exclusive use
vention by the licensee in one field and excluding it in
eld."

restriction was legal and the amplifiers were made and
de the scope of the license, the effect is precisely the
no license whatsoever had been granted to Transformer
And as Pictures Corporation knew the facts, it is in no
ition than if it had manufactured the amplifiers itself
license. It is liable because it has used the invention
cense to do so.

e consequently no occasion to consider what the rights of
s would have been if the amplifier had been manufac-
nder the patent" and "had passed into the hands of a
in the ordinary channels of trade." Nor have we occa-
nsider the effect of a "licensee's notice" which purports
the use of articles lawfully sold.

Affirmed.

tice ROBERTS took no part in the consideration or decision
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Test:

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SUPREME COURT OF THE UNITED STATES.

No. 1.—October Term, 1938.

General Talking Pictures Corp., *vs.* Western Electric Co., Inc., Electric Research Products, et al. } Certiorari to the Circuit Court of Appeals for the Second Circuit.

[November 21, 1938.]

Mr. Justice Black, dissenting.

Almost a century ago, this Court asserted, and time after time thereafter it has reasserted, that when an article described in a patent is sold and "passes to the hands of a purchaser, it is no longer within the limits of the monopoly. It passes outside of it, and is no longer under the protection of the act of Congress. . . . Contracts in relation to it are regulated by the laws of the State, and are subject to State jurisdiction."[1]

[1] Bloomer *v.* McQuewan et al., 14 How. 539, 549-50; see, Chaffee *v.* Boston Belting Co., 22 How. 217, 223; Mitchell *v.* Hawley, 16 Wall. 544, 547; Adams *v.* Burke, 17 Wall. 453; Wade *v.* Metcalf, 129 U. S. 202, 205; Boesch *v.* Graff, 133 U. S. 697, 702; Hobbie *v.* Jennison, 149 U. S. 355; Morgan Envelope Co. *v.* Albany Paper Co., 152 U. S. 425; Keeler *v.* Standard Folding Bed Co., 157 U. S. 659; Bauer *v.* O'Donnell, 229 U. S. 1; Straus *v.* Victor Talking Machine Co., 243 U. S. 490; Motion Picture Co. *v.* Universal Film Co., 243 U. S. 502; Boston Store *v.* Amer. Gramaphone Co., 246 U. S. 8. The rule asserted in these cases is in accord with the views of Thomas Jefferson who served as a member of the first Patent Board established by the first Patent Act of 1790 (1 Stat. 109) and who also drafted the comprehensive Patent Law of 1793 (1 Stat. 318). See, "The Jeffersonian Cyclopedia", p. 680 (Funk and Wagnalls, 1900). The Acts of 1790 and 1793 granted patentees for fourteen years the exclusive right "of making, constructing, using and vending to others to be used." Mr. Jefferson, referring to the general rules adopted by the first Patent Board, said: "One of those [rules] was that a machine *of which we were possessed might be applied by every man to any use of which it is susceptible* and that this right ought not to be taken from him and given to a monopolist, because the first perhaps had occasion so to apply it. Thus a screw for crushing plaster might be employed for crushing corn-cobs. And a chain pump for raising water might be used for raising wheat: this being merely a change of application." "The Writings of Thomas Jefferson", Vol. VI, H. A. Washington, Editor, p. 181 (Published by Order of the Joint Committee of Congress on the Library, 1861). After the Patent Board's duties devolved upon the courts, Mr. Jefferson suggested that the rule be "adopted by the judges" that *"the purchaser of the right to use the invention should be free to apply it to every purpose of which it is susceptible."* *Id.*, p. 372. [Italics supplied.]

United States *v.* General Electric Co., 272 U. S. 476, relied on by the majority here, was not a suit for infringement of a patent, but was an action by the United States under the anti-trust laws. The opinion was written by Chief Justice Taft and applied some of the reasoning of the Button-Fastener case, 77 Fed. 288, in which he had agreed as Circuit Judge to the opinion of Circuit Judge Lurton. Later, this Court in Henry *v.* Dick Co., 224 U. S. 1, with the then Justice Lurton writing the opinion, followed the Button-Fastener case.

A single departure from this judicial interpretation of the patent statute[2] was expressly overruled within five years, and this Court again reasserted that commodities—once sold—were not thereafter "subject to conditions as to use" imposed by patent owners.[3] In result, the judgment here is a second departure from the traditional judicial interpretation of the patent laws.

As a consequence of the return to the interpretation of the patent statutes previously repudiated and expressly overruled, petitioner is enjoined from making full use of, and must account in triple damages for using, tubes and amplifiers which he owns. He became the owner of the tubes by purchase from various retailers authorized by respondents to sell in the open market. He became the owner of the amplifiers by purchase from a manufacturer who—having the complete right to make them—had contracted to sell only for limited uses.[4] The departure here permits the patentee—by virtue of his contract with the manufacturer—to restrict the uses to which this purchaser and owner may put his tubes and amplifiers.

Transformer Company was authorized by the patentee to make and to sell amplifiers. It did make such amplifiers—of a standard

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Motion Picture Co. *v.* Universal Film Co., *supra*, expressly overruled and repudiated the doctrine of the Dick case. In effect, the judgment here once more revives the doctrine of the Button-Fastener case.

The majority opinion also relies upon Mitchell *v.* Hawley, *supra*. It is significant that in the Hawley case the patentee never licensed or transferred his exclusive right to sell; and the license conveyed only "the exclusive right to make, and use 'and to license to others the right to use . . .'" 16 Wall., at 548. That case, therefore, does not justify the judgment here where the patentee's power to vend was both transferred and exercised.

[2] Henry *v.* Dick Co., 224 U. S. 1, decided March 11, 1912.

[3] Motion Picture Co. *v.* Universal Film Co., *supra*, 516. Similarly, the exercise of the right to vend exhausts the right under a patent to control the price at which an article claimed in the patent may subsequently be sold. Bauer *v.* O'Donnell; Straus *v.* Victor Talking Machine Co.; Boston Store *v.* American Gramaphone Co., *supra*.

[4] License Agreement. " . . . That Whereas the Licensors represent that they severally own and/or have the right to grant licenses under various United States Letters Patent relating to Power Supply and to Power Amplifier Units, hereinafter termed Licensed Apparatus, . . .

"1. Each of the Licensors hereby grants under all of the United States Patent useful in the Licensed Apparatus, owned by it and/or with respect to which it has the right to grant licenses, . . . solely and only to the extent and for the uses hereinafter specified and defined, a personal, indivisible, non-transferable and non-exclusive license to the Licensee to *manufacture* at its factory . . . ; and not elsewhere without previous written permission obtained from the Radio Corporation, and *to sell only for radio amateur reception, radio experimental reception, and radio broadcast reception* throughout the United States and its territories or dependencies, Licensed Apparatus so manufactured by the Licensee, . . ." [Italics supplied.] Reasonably interpreted, this contract grants the right to make everything described in the patents; the sole limitation on the right to *make* relates to the place of manufacture. The contract grants the right to *sell* the manufactured articles with an attempt by notice to restrict their use in the hands of owners to whom they are sold.

type usable in many fields,[5] they became its property when made, were *sold* to and became the property of petitioner. The prior opinion in this case, both courts below and the opinion on this rehearing, *all* refer to the transaction between Transformer Company and petitioner as a *sale*. Even the very contract authorizing the Transformer Company to make and sell the amplifiers provided "That for the purpose of this agreement all Licensed Apparatus shall be considered as 'sold' when the Licensed Apparatus has been billed out, or if not billed out, when it has been delivered, shipped, or mailed."

Notice to the purchaser in any form could not—under the patent law—limit or restrict the use of the amplifiers after they were sold[6] and knowledge by both vendor and purchaser that the articles were purchased for use outside the "field" for which the vendor had been given the right to sell, made the transaction between them no less a sale.[7] Had petitioner—after making the purchase—decided *not* to use these amplifiers in the forbidden fields, or had they been destroyed prior to such use, certainly the mere state of mind of the parties at the time of sale would not have made them both infringers.

Indeed, petitioner could use the amplifiers at all only in combination with tubes which it purchased on the open market from retailers authorized by respondents to sell. Therefore, even if the state of mind of vendor and purchaser were material, Transformer Company could be considered an infringer only because it sold a commodity which might—depending on possible events after the sale—be used in infringing combination with another lawfully purchased commodity. The patent law was not intended to accomplish such result.[8]

Petitioner has persistently contended throughout this litigation that no existing trade practice permits a patentee—under guise of a "license"—to extend his monopoly to commodities after sale, and

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[5] One of respondents' officials testified: "These things, these vacuum tubes and the circuits on which we have patents, are useful in various of these fields and applicable to many fields. And if we granted licenses not restricted to any particular field, the same things could be used in these other fields." The injunction sustained here was decreed by the District Judge on the basis of his conclusion that the amplifiers put to commercial use by petitioner could also be used "for experimental or radio amateur use" as the patentee had desired. 16 F. Supp. 303. Thus, it appears that the very amplifiers made and sold to petitioner were suitable for all "fields."

[6] "The statutes relating to patents do not provide for any such notice and it can derive no aid from them." Motion Picture Co. case, *supra*, 509; Bauer *v.* O'Donnell, *supra*; Straus case, *supra*; Boston Store case, *supra*; Carbice Corporation *v.* American Patents Corp., 283 U. S. 27.

[7] Hobbie *v.* Jennison, *supra*; Keeler case, *supra*; Straus case, *supra*.

[8] Cf., Morgan Envelope Co. *v.* Albany Paper Co., *supra*.

has not stipulated otherwise.[9] Neither stipulation nor practi could justify extension of patent monopoly beyond the limits legality fixed by Congress and recognized by this Court for ov three-quarters of a century. "The statutory authority to grant t exclusive right to 'use' a patented machine . . . is precisely th same, as the authority to grant the exclusive right to 'vend' . . ." A widespread practice of restricting the resale price of articles d scribed in patents[11] did not prevent this Court from holding tha once the statutory right to vend has been exercised "the added-r striction is beyond the protection and purpose of the act."[12] Sim larly, a "common practice . . . to grant written licenses . . restricted to one or more . . . fields of . . . use" cannot pr vent the application of "that line of cases in which this court ha from the beginning held that a patentee who has parted with a pa ented machine by passing title to a purchaser has placed the articl beyond the limits of the monopoly secured by the patent act."[13]

Mr. Justice REED joins in this dissent.

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[9] The negotiations for stipulation were as follows:

"Mr. Neave: Mr. Darby, will you agree that it is common practice whe a patented invention is applicable to different uses, to grant written licens under United States patents restricted to one or more of the several fields use, permitting exclusive or non-exclusive use of the invention by the licens in one field and excluding its use in another field?

"Mr. Darby: I do not agree. As a matter of fact I believe that just th opposite or the contrary is true."

"Mr. Darby: . . . Mr. Ashton called me up and told me that M W. H. Davis had entered into such a stipulation in the Independent Wirele case, and asked me if I would do the same thing. I told him I could not co scientiously, because not only could I not agree that that was the common pra tice, but I know I thoroughly disagree with whether it was or not. In other wor I was confident that was not the common practice. In my own case, I know would not allow my own clients to do it, because I did not think it was legal.

"Mr. Darby: I am willing to stipulate it, if it will be of any assistan to Mr. Ashton, that it is, if he tells me it is, the common practice of th Western Electric Company and the Radio Corporation to do that."

"Mr. Darby: It is stipulated that it is common practice where a patent invention is applicable to different uses, to grant written licenses to manufa turers under United States Letters Patents restricted to one or more of th several fields of use permitting the exclusive or non-exclusive use of the i vention by the licensee in one field and excluding its use in another field. stipulate that and I urge, however, objection to its receipt for any evidenti purpose, as irrelevant and immaterial what the common practice is, on th issue of law as to whether or not it is legal."

[10] Motion Picture Co. case, *supra*, 516.

[11] See, "Emancipation of Patented Articles", Walter H. Chamberlin, 6 I Law Review, 357.

[12] Bauer case, *supra*, 17.

[13] *Id.*

END